NONPAREIL CORKBOARD INSVLATION

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PHILADELPHIA PENNSYLVANIA

NONPAREIL CORKBOARD INSULATION

FOR

COLD STORAGE WAREHOUSES ABATTOIRS BREWERIES ICE PLANTS FUR STORAGE VAULTS DAIRIES CREAMERIES CANDY FACTORIES BAKERIES FISH FREEZERS CANNERIES REFRIGERATORS FREEZING TANKS AND GENERALLY WHEREVER REFRIGERATION IS EMPLOYED

TRADE
NONPAREIL CORK
MARK

ARMSTRONG CORK COMPANY
INSULATION DEPARTMENT
PITTSBURGH PENNSYLVANIA

BRANCHES AND REPRESENTATIVES

NEW YORK WASHINGTON CINCINNATI NEW ORLEANS
BOSTON ATLANTA CHICAGO SAN FRANCISCO
PHILADELPHIA CLEVELAND ST. LOUIS SEATTLE
MONTREAL

The Cork Oak—Native of the Spanish Peninsula and Northern Africa, from the outer bark of which Nonpareil Corkboard is made.

Nonpareil Corkboard Insulation

Nonpareil Cork—Trade-Mark

THE VITAL IMPORTANCE OF INSULATION For a good many centuries men have known better than to store wine in leaky vessels. Today no one allows steam, that ought to be turning machinery, to escape from broken pipes. Nor is electric power permitted to go to waste by failure to insulate properly the supports on which the wires are carried. Yet many men pump refrigeration into rooms day after day, making little or no intelligent effort to prevent the heat from constantly leaking back.

ITS IMPORTANCE IS FREQUENTLY OVERLOOKED The reason for this neglect may be sought in several quarters. Heat is a very commonplace thing. We experience its effects every hour that passes. There does not seem to be anything particularly wonderful about it. But if we stop to consider, we find ourselves face to face with the fact that of all known forms of energy, it is the most powerful and all-pervading. We can shut out the light; certain substances are impervious even to X-rays, but as for heat, nothing will completely stop its passage.

No one needs to be told the part the refrigerating machine is to play in keeping a room cooled to proper temperature. One can see the wheels go round and watch the measured stroke of the compressor. As for the insulating material, what good does it do? So the average man is apt to reason. Get anything that will fill up space fairly well, stuff the walls, floors and ceilings, and

let it go at that. Insulation does not show; it will all be covered up anyway. Why bother much about it, or spend time and money in designing and installing it?

GOOD INSULATION IS TRUE ECONOMY

Right at this point, by following this natural but erroneous reasoning, many plant owners make their first big mistake, the results of which follow hard on their trail for many a year, revealing themselves in the form of increased operating expense, rapid depreciation of machinery and insulation repairs. The fact is that the insulation of any cold storage room is just as important as the refrigerating machinery. Three-fourths of the work of the machine in the average plant is done to remove the heat that leaks in through the walls, floors and ceilings; but one-fourth goes to cool the goods in storage. If you use ice, seventy-five out of every one hundred pounds put in your coolers is melted by the heat that works its way in from all sides. This loss cannot be prevented entirely, because no material is heat-proof. It is possible, though, to cut it down to a point, neither above which nor below which you can profitably afford to go. If any plant is to operate on a truly economical basis, it must be protected against heat to a point where the saving in operating expense, effected by additional insulation, would not be offset by the extra cost involved.

OPINION OF AN ENGINEER

As a well-known refrigerating engineer has tersely said: "Insulation should be considered in the light of a permanent investment, just as buildings and equipment, the returns of

which should be based on the savings effected by the lower operating cost. It is a great deal cheaper to prevent heat from entering a building than to remove it by means of refrigeration."

THE TRANSMISSION OF HEAT

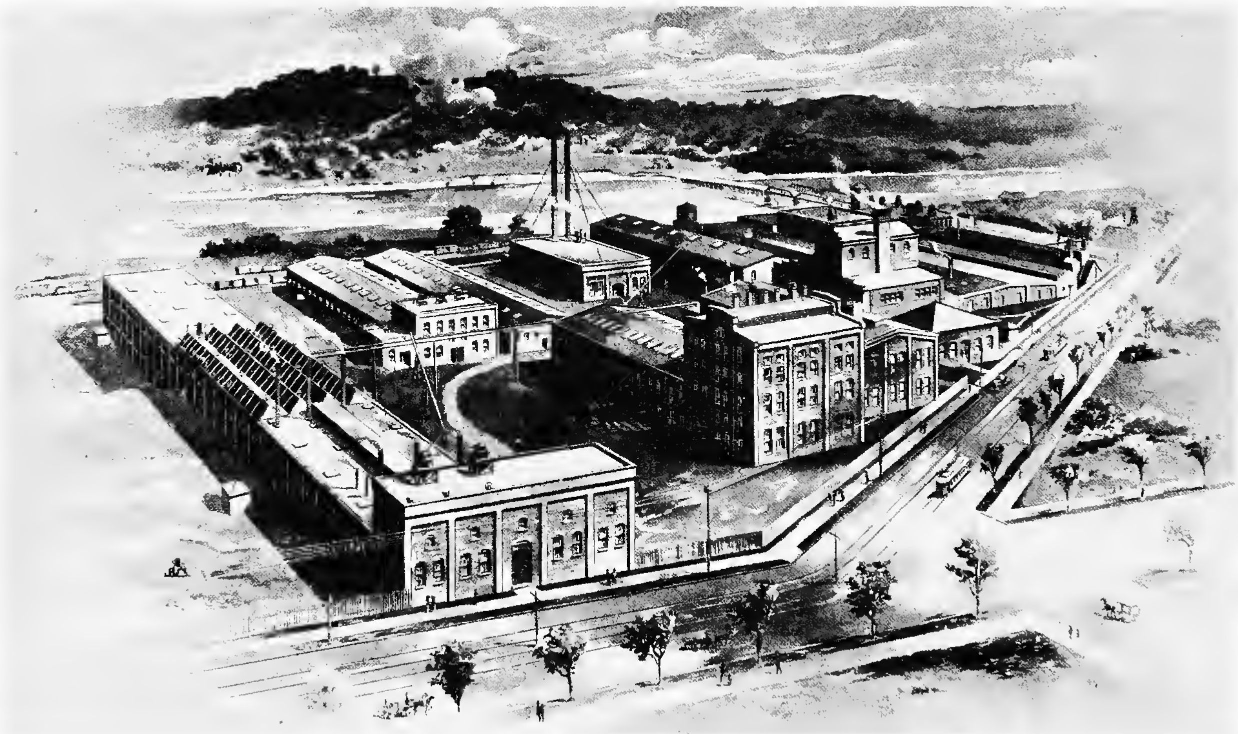
The word *insulation* is derived from a Latin word meaning *island*. The significance, therefore, of the definition of *insulate*, as given in the dictionary, will be readily grasped: "To place in a detached situation, having no communication with surrounding objects." In insulating a cold storage room, what the engineer tries to do, is to make it an island in the ocean of heat.

RADIATION

Heat, though, has several ways of getting about. It can pass through space on the ether waves without appreciably heating the air. Stand in front of a stove and the truth of this assertion is self-evident. Or, perhaps, the sensation of warmth that one feels in bright sunlight on a cool day is a better illustration of the *radiation* of heat, as this method of its transference is called.

CONDUCTION

When the problem of insulating a cold storage room is under consideration, however, the other two ways that heat moves are of more importance. By *conduction* is meant the transference of heat waves from one molecule or particle of matter to another. For instance, put one end of a poker in the fire and soon the other end will get hot, although far removed from the source of heat. This is exactly the process that goes on in the walls of a cold storage room. The outside is heated by the sun's rays or the warm air. The molecules on the surface are first set in motion. Gradually



Factory at Beaver Falls, Pa., Covering Twelve Acres.
This plant is the largest in the world devoted exclusively to the manufacture of cork insulating materials.

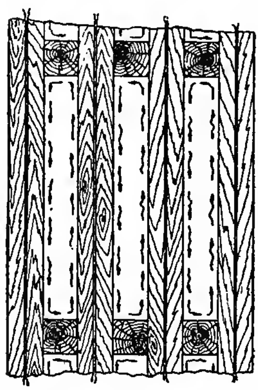
the vibratory movement spreads and goes deeper and deeper into the wall. When the molecular excitement gets into the insulation, it travels forward less rapidly. The progress of the heat is impeded, just as piling along the water front breaks the force of the incoming waves. Still, some of the heat eventually passes through, the amount depending upon the efficiency of the insulation. Slowly but surely the temperature of the room rises, unless refrigeration is continuously applied to offset the heat leakage.

The heat conductivity of dense substances—metals, whose molecules are heavy and close together—is very high; the conductivity of lighter material, such as wood, is less, while that of the gases is extremely low. Hence, air, the most available gas, is the most efficient insulator that can be had, if a vacuum, impracticable on a large scale, be excepted. But the problem is to confine it so that it cannot circulate; for the transmission of

CONVECTION heat is also effected by another means called *convection,* or in other words, the carrying of heat from one point or object to another by means of some outside agent, such as air or water, or any gas or fluid. Convection is the principle utilized in the ordinary house furnace. The outside air is drawn in through a duct, is heated, and rises through pipes to the various rooms, its place being taken by a new supply of cold, heavy air, which passes through the same process.

PASSAGE OF HEAT THROUGH INSULATION

On a miniature scale, this is exactly what takes place in every form of insulation. The side next to the outer air is warmer than the side next to the cold room. The air against the outer wall of each air space in the insulation becomes heated and rises, its place being taken by the cold air from the other side. As this becomes warm, it forces its way upward; the other part, having gradually cooled, drops to the bottom, and thus a constant circulation is set up inside the air space itself. This movement tends to equalize the temperature on both sides of the air space and will continue as long as there is any difference in temperature. The fewer the air spaces, the more rapidly will heat pass from one side of insulation to the other. Therefore, the best insulation is that which embodies the greatest number of the smallest possible air spaces, for the smaller the air spaces the less extensive will be the effect of the circulation of the air confined therein. The problem is then, so far as the nonconduction of heat is concerned, to find some material which contains a large amount of entrapped air absolutely confined in minute particles.



Convection in Boards and Air Space Insulation.

REQUIREMENTS OF GOOD COLD STORAGE INSULATION

To meet the demands of modern cold storage construction, however, suitable insulating material has to possess a number of other qualifications besides being an excellent nonconductor of heat. The plant owner demands that the insulation he installs shall retain its efficiency indefinitely. This is merely another way of saying that it must not absorb moisture, for water is a good conductor of heat, and any insulating material that will absorb it, will in a short time become worthless.

Sanitation requires that all insulating material shall keep free from rot, mold and offensive odors, and be vermin and germ proof. The delicacy of certain food stuffs, such as milk, cream, butter and eggs, requires that the insulation shall be odorless, as otherwise there is danger of taint.

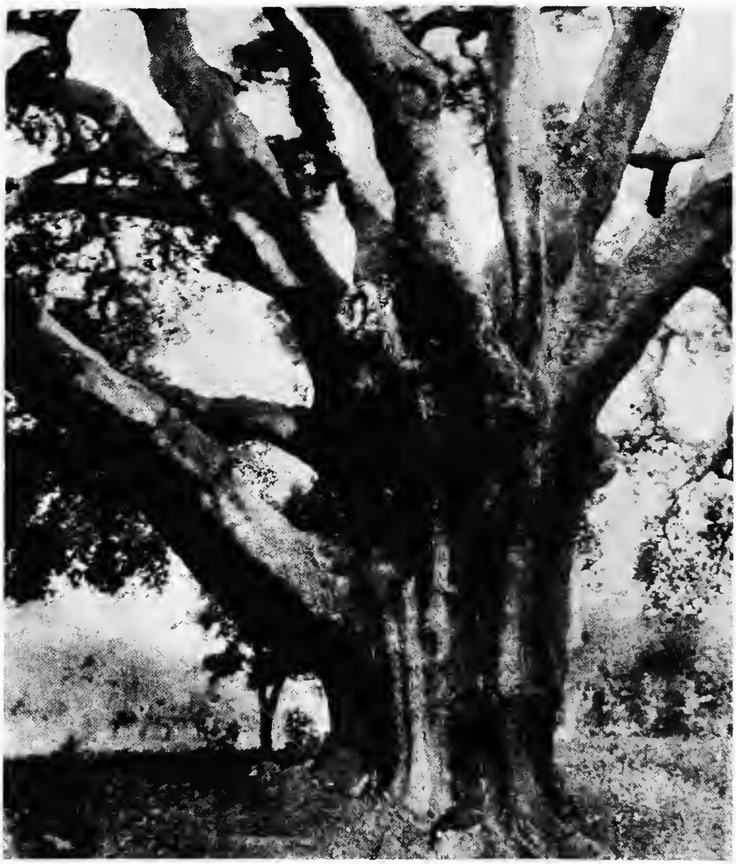
Economical building calls for the use of an insulation that will occupy the least possible room and leave the maximum amount of storage space. Expediency demands that the material be easily erected and have ample structural strength. The fire underwriters insist on the fire risk being reduced, as far as possible, by the installation of some material which will not only be slow burning, but will leave no flues in the walls to assist in the spreading of fire once under way. Finally, the material must be reasonable in cost.

Nonpareil Corkboard

Nonpareil Corkboard alone meets every one of these requirements:

I. The Heat Conductivity of Nonpareil Corkboard is the Lowest of any Commercial Insulator.

NATURAL CORK Cork is the outer bark of the cork oak, a tree that flourishes in the hot, semi-arid climate of the Spanish Peninsula and Northern Africa.

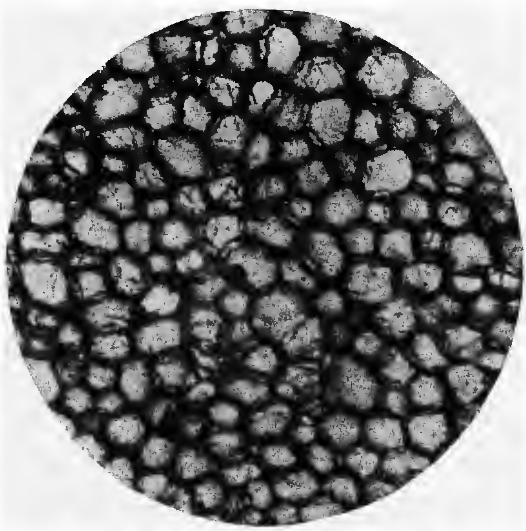


Gnarled Trunk of an old Cork Tree, showing heavy outer Bark—the Cork of Commerce.

Sheathing trunk and branches, it prevents the sun's rays and the parching winds from drying up the cool, life-giving sap that mounts upward through the inner bark—the real skin. When fire sweeps through the forests, the cork tree alone survives, thanks to its protecting shield of bark. It is not surprising, therefore, that natural cork is found to be an excellent nonconductor of heat. For the reason, one need not seek far.

CELLULAR STRUCTURE OF CORK

Put a piece of cork under the microscope. Its peculiar structure is then plainly seen—millions of tiny cells. Each one of these minute cells contains a bit of entrapped air, and each one, moreover, is hermetically sealed by nature herself and thus rendered impervious to air and moisture. This peculiar cellular structure of cork has a double bearing on its value as an insulating material, accounting not only for its low heat conductivity, but as we shall see, for its continued efficiency and durability as well.



Natural Cork magnified 180 Diameters, showing confined air cells.

Many years ago, the merits of granulated cork as an insulating material were generally recognized, but it was not until about fifteen years since, that widening knowledge of the technique of refrigeration created a demand for cork insulation in sheet or board form. To satisfy this demand, Nonpareil Corkboard, the pioneer type of solid insulation, was put on the market, and it has remained the standard through all the years that have elapsed.

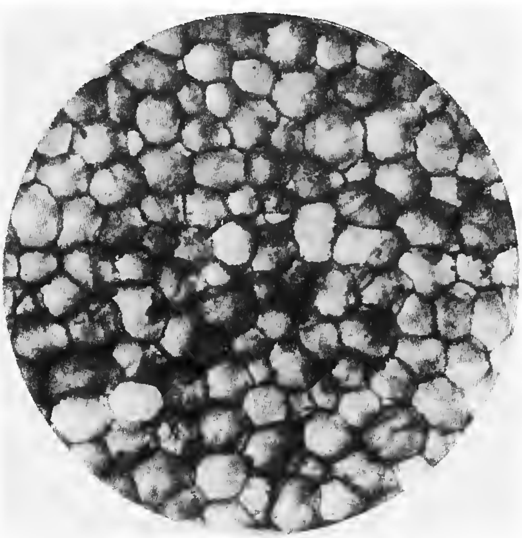
NONPAREIL CORKBOARD Nonpareil Corkboard (Nonpareil Cork Trade-Mark) consists of pure granulated cork, slightly compressed, baked at a moderate temperature, and passed through a process which

Nonpareil Corkboard

insures permanency of form. No foreign binder is used, for under the peculiar process of its manufacture none is necessary. It is cork, pure cork, and nothing but cork, and in this, stands in marked distinction from all other forms of corkboard which have later appeared. All such contain some foreign binder—glue, asphalt, pitch, or cement—and aside from other points of inferiority, are of necessity, from the presence of such

substances, less efficient as nonconductors. In Nonpareil Corkboard only cork, the real insulating agent, enters.

The process of manufacture through which Nonpareil Corkboard passes, increases the insulating efficiency of the raw material by driving off part of the volatile matter and all moisture, thereby increasing the volume of confined air. Moreover, the natural gum, liquified by the heat, spreads out over the surface of each granule and effectually prevents the re-entrance of moisture. That the cellular structure of the cork itself is not affected in any way by the slight compression and baking, to which it is subjected, may be seen by examining a piece of Nonpareil Corkboard microscopically. The cut of natural cork on the second page preceding, and the one that appears here are on exactly the same scale and hence fair comparison can be made.



Nonpareil Corkboard magnified 180 Diameters, showing confined air cells.

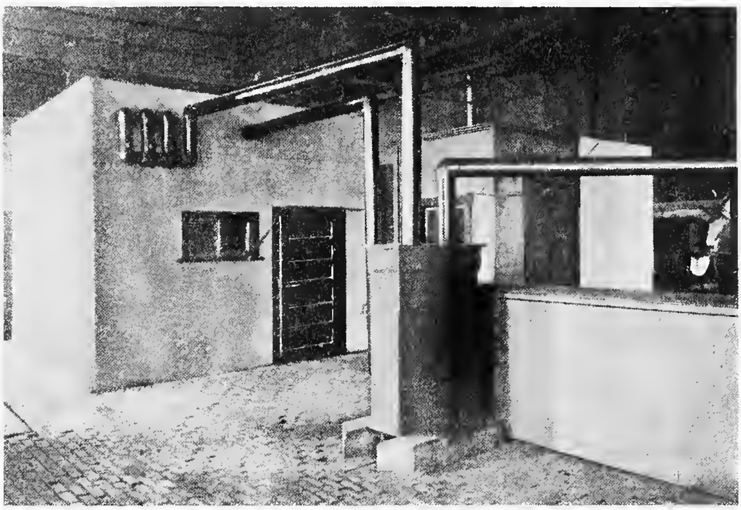
DETERMINATION OF THE HEAT CONDUCTIVITY OF INSULATING MATERIALS To determine accurately the heat conductivity of any material is a very complicated as well as expensive proceeding. Many experiments along these lines have been made, both by physicists in the interests of science, and by engineers on behalf of their clients. The results have been widely at variance and one could not expect them to be otherwise, if familiar with the conditions under which they were obtained. In practically all such tests either the direct contact method has been used; viz., applying a chilled or a heated surface to one side of the material under test and measuring the amount of heat passing through; or else makeshift apparatus, consisting of a small box lined with the material under test, cooled by melting ice.

OLD METHODS VERSUS NEW The first method is objectionable because air contact and not direct contact prevails in cold storage construction; and if the results thus obtained are used in designing cold storage insulation, grave mistakes will surely follow. The second method is, from its mere crudeness, absolutely unreliable. So many varying factors are brought into play, that the results are not only inaccurate, but of no value in determining even relative efficiency. The only fair way to test the heat conductivity of cold storage insulation is on a comparatively large scale, under conditions paralleling those found in actual practice; viz., air contact, cold storage

temperatures and mechanical refrigeration, combined with positively accurate methods of measuring the heat loss.

THERMAL INSULATION TESTING STATION

With these facts in mind, and determined to get at the truth for their own, as well as their customers' protection, the Armstrong Cork Company installed at Pittsburgh, some years ago, a heat transmission testing plant which is



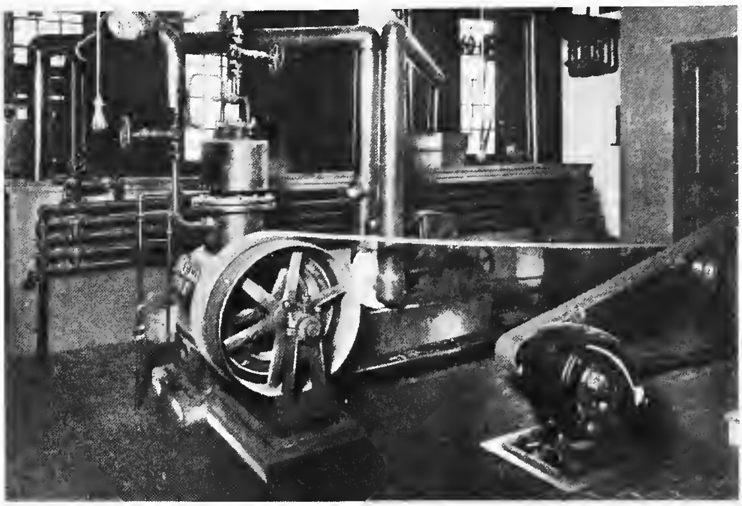
Testing Room.

absolutely unique in scope, and in the character of the experiments which it makes possible. It is the only experimental station of its kind in the world. Upwards of $20,000 has been spent in its construction and in the tests already made.

DESCRIPTION

The plant (see plan) consists of the testing room (A) twelve feet square by ten feet

high, the walls, ceiling and floor of which are insulated with six inches of corkboard, so that any desired temperature as low as 0° F. can be maintained without variation by means of a three-ton refrigerating machine. The brine circu-



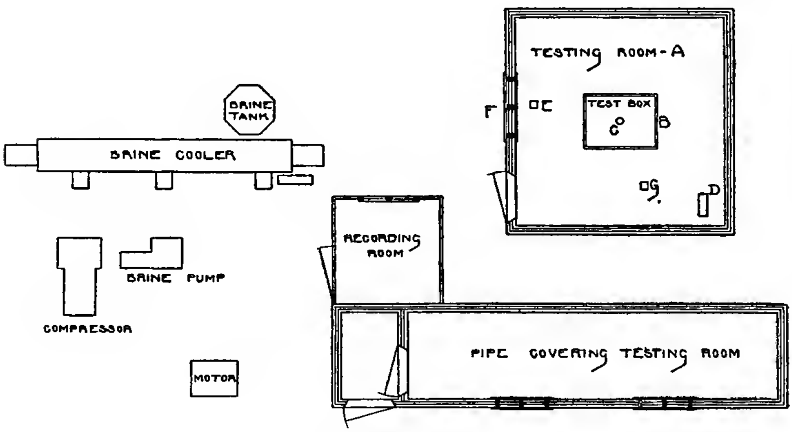
The Testing Plant—Refrigerating Machinery.

lating system is used; a twelve horse power motor supplies the power.

HOW TESTS ARE MADE

The method employed in making tests is as follows: Inside of the testing room (A) there is built a box (B) of the material to be tested, measuring from three to four feet each way and affording, therefore, a radiating surface of from fifty to ninety-six square feet. Little or no lumber is used when the material is self-supporting, for it is desirable, of course, to eliminate foreign material to the greatest possible

extent, but when loose materials, such as granulated cork, shavings, cinders, mineral wool, etc., are being tested, a containing box of lumber has to be utilized. Before the test box (B) is sealed up, an electric heating coil and a small electric fan are placed inside, the holes through which the wires pass and all joints of the test box being hermetically closed with a thin coating of hot asphalt. The test box is raised a foot above the floor of the testing room on light supports, thus obtaining air contact on every side. In the



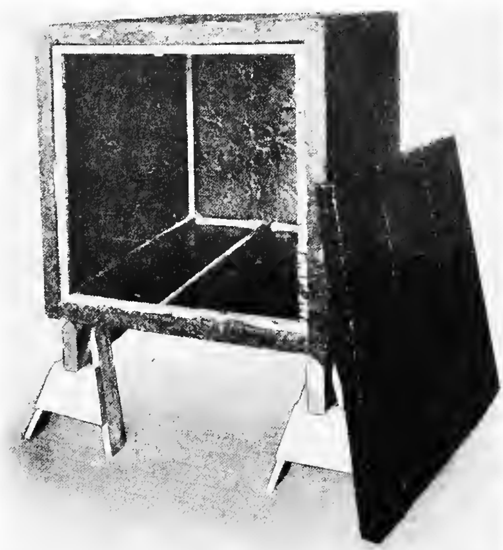
Plan of Testing Plant.

A—Testing Room. B—Test Box. C—Test Box Thermometer.
D—Fan in Testing Room. E—Testing Room Thermometer.
F—Window. G—Recording Thermometer.

top of the test box, a long stem thermometer (C) is sealed, the scale protruding above so that the temperature inside may be observed constantly during the progress of the test. In the testing room, another electric fan (D) keeps up a constant circulation of air about the test box, ensuring uniform temperature on all sides. A

thermometer (E) is hung in the testing room opposite the window (F), so that the temperature within can be determined by the operator without entering the room. The recording thermometer (G) checks the readings thus made.

When all is ready, both the refrigeration and the electric current supplying the heating coil

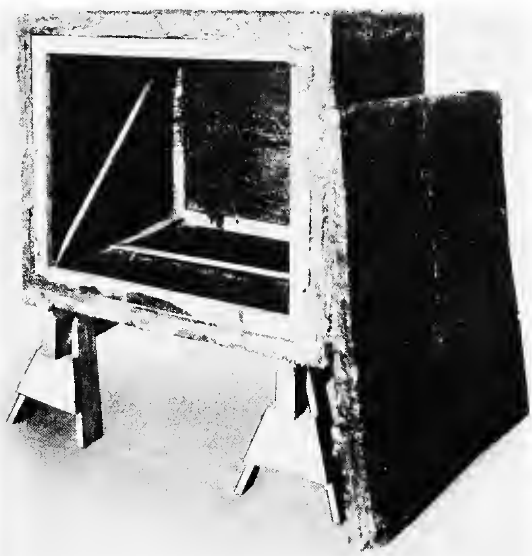


Test Box Built of Two-inch Nonpareil Corkboard.

and the fans are turned on and at least forty-eight hours allowed to elapse before any observations are taken, to obtain constant temperature conditions and to insure the uniform transmission of heat through the test box. 90° F. is usually the temperature at which the test box is held; 10° the temperature of the testing room, the difference, therefore, being 80° F. This is purely

an arbitrary matter, and in making check tests the temperature is usually varied; for instance, by holding the test box at 80°, the testing room at 10°; or, the test box at 85° and the testing room at 15°.

After conditions have become constant, observations are made every ten or fifteen minutes, as may be determined upon, for a period of from three to five hours. The amperage and voltage of the currents supplying the heating coil and



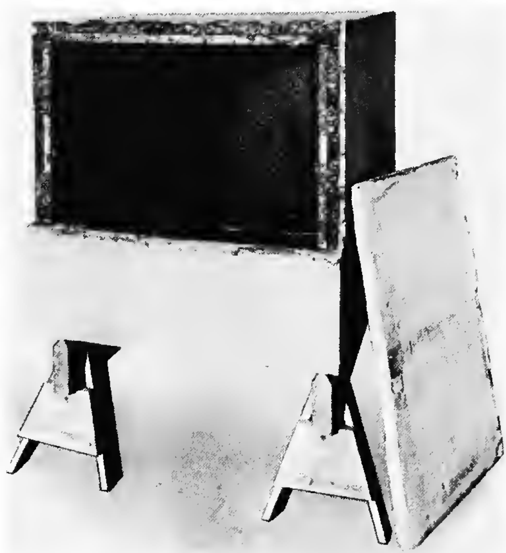
Test Box Built of Two-inch Lith.

the small fan sealed up in the test box, respectively, the temperature of the testing room, and the temperature of the test box, all are carefully read and recorded. During the duration of the test, these temperatures are kept practically

constant, either by controlling the ammonia expansion valve and the brine circulation, or by increasing or decreasing, as may be required, the current supplied to the heating coil in the test box.

COMPUTING THE RESULTS

The heat transmission is computed in the following manner: The average difference in temperature between the test box



Test Box Built of One-inch Nonpareil Corkboard, with one-half inch Portland cement plaster finish.

and the testing room, the average voltage, and the average amperage of the currents supplying the small fan and heating coil, respectively, are first determined. The test box is carefully measured and the mean area computed. With this data, by means of the following formula, the heat transmission per square foot, per degree

difference in temperature, for twenty-four hours, in British Thermal Units, is readily computed:

$$746 \text{ Watts} = 1 \text{ H. P.}$$

$$1 \text{ H. P.} = 33{,}000 \text{ ft. lbs.}$$

$$1 \text{ Watt} = \frac{33{,}000}{746} = 44.236 \text{ ft. lbs.}$$

$$778 \text{ ft. lbs.} = 1 \text{ B. T. U.}$$

$$1 \text{ Watt} = \frac{44.236}{778} = .05685 \text{ B. T. U.}$$

$$1440 \text{ Minutes} = 24 \text{ hours.}$$

Let F. A. = Average Amperage of Fan Circuit.
F. V. = Average Voltage of Fan Circuit.
C. A. = Average Amperage of Heating Coil Circuit.
C. V. = Average Voltage of Heating Coil Circuit.

1 Ampere x 1 Volt = 1 Watt.

Therefore (F. A. x F. V.) + (C. A. x C. V.)
= Average Watts supplied Test Box per minute.

Let D = Average Difference in Temperature of Test Box and Testing Room.

Then

$$\frac{(\text{F. A.} \times \text{F. V.} + (\text{C. A.} \times \text{C. V.}) \times 1440 \times .05685}{\text{D} \times \text{Mean Area of Test Box}}$$

= B. T. U. per square foot per degree difference in temperature for twenty-four hours.

A British Thermal Unit, or "B. T. U."—the unit of measurement—is the amount of heat required to raise a pound of water one degree Fahrenheit.

STANDARD BASIS OF COMPARISON Since the transmission through any insulating material of uniform structure is in inverse proportion to its thickness, the results thus obtained may be readily reduced to the standard one-inch thickness basis. All results are checked by means of several runs, and, in addition, usually by two or more observers working independently in ignorance of the other's results. The instruments with which the electric currents are measured are of the most delicate type and with their assistance the amount of heat driven into the test box may be determined with absolute accuracy.

LOG OF A TEST

The complete log of a test on two-inch Nonpareil Corkboard, made November 6th, 1907, is shown below:

Log of Test on Two-inch Nonpareil Corkboard

November 6th, 1907.

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	FAN		COIL	
				Volts	Amp.	Volts	Amp.
10:50	90.0	9.8	80.2	103.8	.50	45.4	2.37
11:00	90.0	9.7	80.3	104.5	.49	43.8	2.31
11:10	90.0	9.7	80.3	104.3	.50	41.9	2.42
11:20	90.0	9.8	80.2	105.0	.50	42.7	2.31
11:30	90.0	9.7	80.3	105.0	.50	44.0	2.27
11:40	90.0	9.7	80.3	105.0	.50	43.7	2.30
11:50	90.0	9.7	80.3	104.4	.49	43.5	2.29
12:00	90.0	9.5	80.5	105.0	.50	44.0	2.32
12:10	90.0	9.6	80.4	107.0	.50	43.1	2.28
12:20	90.0	9.7	80.3	107.5	.50	43.2	2.29
12:30	89.9	9.8	80.1	106.7	.50	43.5	2.30
12:40	89.9	9.8	80.1	106.5	.50	43.8	2.30
12:50	89.9	9.6	80.3	107.1	.49	43.7	2.31
1:00	89.9	9.5	80.4	106.0	.49	43.6	2.30
1:10	89.9	9.6	80.3	106.5	.49	43.5	2.29
1:20	90.0	9.6	80.4	106.5	.50	45.5	2.38
1:30	90.0	9.5	80.5	105.3	.50	45.6	2.38
1:40	90.1	9.5	80.6	105.5	.50	45.5	2.38
1:50	90.1	9.4	80.7	106.0	.50	44.3	2.32
2:00	90.2	9.6	80.6	105.5	.50	43.0	2.27
2:10	90.1	9.7	80.4	105.8	.50	43.3	2.27
2:20	90.0	9.7	80.3	105.0	.50	43.2	2.25
2:30	90.0	9.6	80.4	105.5	.50	44.0	2.32
2:40	90.0	9.5	80.5	105.8	.50	43.8	2.33
2:50	90.0	9.5	80.5	106.0	.50	44.5	2.33
3:00	90.0	9.6	80.4	105.5	.50	44.0	2.33
Average of 26 readings			80.37	105.64	.498	43.85	2.316

A correction of .08 must be subtracted from fan ammeter readings.

Mean area of box—48.72 square feet.

$$\frac{(105.64 \times .498) + (43.85 \times 2.316) \times 1440 \times 0.05685}{80.37 \times 48.72} = 3.0 \text{ B. T. U.}$$

2″ Nonpareil = 3.0 } B. T. U. per square foot per 1° difference
Therefore 1″ Nonpareil = 6.0 } of temperature for twenty-four hours.

REPORT OF WALTER KENNEDY

In April and May, 1909, Mr. Walter Kennedy, the well-known mechanical engineer of Pittsburgh, conducted a series of experiments at this plant on Nonpareil Corkboard,

Rock Cork (mineral wool), Lith, Waterproof Lith, Indurated Fibre Board and a Composition Corkboard (granulated cork and asphalt). His report, showing conclusively that Nonpareil Corkboard is twelve per cent more efficient as a nonconductor of heat than its nearest competitor, follows:

Walter Kennedy
Engineer

Pittsburgh, Pa., May 17, 1909.

Armstrong Cork Company,
Insulation Department,
Pittsburgh, Pa.

Gentlemen:—

In accordance with your instructions, I have tested for heat transmission, cold storage insulating materials, as follows:

1. *Waterproof Lith,* a fibrous compressed mineral wool board, impregnated with oil vapor.

2. *Rock Cork,* a fibrous mineral wool board, slightly compressed, impregnated with oil vapor, paraffine or some similar substance.

3. *Indurated Fibre Board,* a wood pulp board, rather densely compressed.

4. *Regular Lith,* a fibrous compressed mineral wool board, without the oily ingredient found in Waterproof Lith.

5. *Nonpareil Corkboard,* a board composed of pure granulated cork, slightly compressed and baked.

6. *A Composition Corkboard,* composed of granulated cork mixed with asphalt.

All of the materials tested were two inches in thickness, the required amount of each being purchased in the open market, with the exception of the Nonpareil and the Composition Corkboard, which were taken at random by me from your regular stock. No effort was made to select material that would be either above or below the average quality or weight per square foot.

These tests were made with the best possible facilities, using for the purpose a thermal insulation testing plant, which was designed and built especially for making these and similar tests, and is the only plant in the world, to the best of my knowledge, where tests can be made on heat transmission of insulating materials under conditions paralleling those found in actual practice. The testing plant consists of a room twelve feet square and ten feet high, well insulated with corkboard on every side. By means of a small refrigerating machine any desired temperature above 0° F. can easily be maintained. The test boxes, built of the various materials under test, are comparatively large, each having a radiating surface of about fifty square feet. The plant is equipped with an office in which are located instruments for measuring the heat generated and the recording gauge to show the temperature inside the testing room; it is also provided with thermometers for taking the temperature both

inside of the testing room and inside of the box to be tested. These thermometers can be read at any time with magnifying glasses through a window conveniently located, without going into the testing room. The different parts of this apparatus have been carefully selected for this purpose; in fact, they cannot be used for anything else. They have been arranged with relation to each other, and in the most convenient manner for regulating them and taking observations. The ammeters and volt-meters are the most sensitive and accurate that can be obtained.

The building in which this entire plant is housed is equipped with power, shafting, work-benches, saw-table, and all other tools that are used in making boxes for testing purposes. The plant could not be better designed or equipped for making a test that is parallel with cold storage conditions, and no expense has been spared either in designing or equipping the plant and apparatus for making these tests. This plant is permanently located in a large, well-lighted, fireproof building, and occupies this valuable space all the time, whether it is being used for testing materials, or not, and in my judgment, renders it possible to overcome all the objections that have been urged against the crude methods heretofore in general use; viz., the direct contact method, the meltage of ice in a small box, etc., which create artificial conditions, entirely different from those encountered in actual service, or else introduce certain indeterminable factors, such as the temperature

of the pieces of ice used, which render the results thoroughly unreliable.

The procedure in making my tests was as follows: The test box was placed inside of the testing room, which is thoroughly insulated and heavily piped. Inside the test box itself was installed a small electric fan to cause circulation of air and uniform temperature, and an electric heating coil, and in the top a long stem thermometer, the holes for it and the wires, together with all joints in the box, being hermetically sealed with a thin coating of hot asphalt. Another electric fan, in the testing room, kept the temperature uniform on all sides of the test box, which was raised a foot above the floor on light supports, so as to obtain air contact on every side. After constant temperature conditions inside and out had been obtained, twenty-four hours were allowed to elapse to insure the uniform transfer of heat through the sides of the test box before any readings were taken. The test box was held at approximately 90° F. by regulating the amount of current supplied the heating coil. The temperature of the testing room was 10°, hence the difference in temperature was approximately 80° F.

After conditions had become constant, readings were taken as follows: The temperature of the test room, the temperature of the test box, the voltage and amperage of the current supplying the small fan in the test box, and the voltage and amperage of the current supplying the heating coil in the test box. At the conclusion of each test the

average difference in temperature between the test room and the test box, the average voltage and amperage of the current supplying the heating coil and fan, respectively, and the mean area of the test box were computed. Then, with the following formula, the transmission per square foot, per degree difference in temperature inside and out, for twenty-four hours, was readily determined:

$$746 \text{ Watts} = 1 \text{ H. P.}$$
$$1 \text{ H. P.} = 33{,}000 \text{ ft. lbs.}$$
$$1 \text{ Watt} = \frac{33{,}000}{746} = 44.236 \text{ ft. lbs.}$$
$$778 \text{ ft. lbs.} = 1 \text{ B. T. U.}$$
$$1 \text{ Watt} = \frac{44.236}{778} = .05685 \text{ B. T. U.}$$
$$1440 \text{ Minutes} = 24 \text{ hours.}$$

Let F. A. = Average Amperage of Fan Circuit.
F. V. = Average Voltage of Fan Circuit.
C. A. = Average Amperage of Heating Coil Circuit.
C. V. = Average Voltage of Heating Coil Circuit.

1 Volt x 1 Ampere = 1 Watt

Therefore (F. A. x F. V.) + (C. A. x C. V.)
= Average Watts supplied Test Box per minute.

Let D = Average Difference in Temperature between Test Box and Testing Room.

Then

$$\frac{(\text{F. A.} \times \text{F. V.}) + (\text{C. A.} \times \text{C. V.}) \times 1440 \times .05685}{\text{D} \times \text{Mean Area of Test Box}}$$

= B. T. U. per square foot per degree difference in temperature per twenty-four hours.

The following tables give the full record of tests:

Test No. 1 **Nonpareil Corkboard** April 23, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
10:00	10.0	91.0	81.0	48.0	2.35	103.8	.5
10:15	9.8	90.0	80.2	46.8	2.20	103.5	.5
10:30	9.5	90.0	80.5	47.0	2.20	105.0	.5
10:45	9.0	90.0	81.0	47.0	2.22	105.0	.5
11:00	9.2	90.0	80.8	47.0	2.22	105.0	.5
11:15	9.5	90.0	80.5	47.0	2.22	105.0	.5
11:30	10.0	90.0	80.0	47.5	2.25	106.0	.5
11:45	10.2	89.5	79.3	43.5	2.1	107.0	.5
12:00	10.8	89.0	78.2	46.0	2.2	107.0	.5
2:45	10.0	90.0	80.0	45.0	2.12	104.5	.5
3:00	10.0	90.0	80.0	44.2	2.1	103.5	.5
3:15	10.2	89.5	79.3	45.0	2.15	106.0	.5
3:30	10.5	89.0	78.5	44.5	2.1	104.0	.5
3:45	10.2	89.5	79.3	46.2	2.2	104.3	.5
4:00	10.0	89.5	79.5	46.0	2.2	104.0	.5
4:15	9.8	89.5	79.7	47.0	2.22	106.0	.5
4:30	10.0	89.8	79.8	47.0	2.22	107.0	.5
4:45	10.0	89.8	79.8	47.0	2.2	107.0	.5
5:00	10.5	90.0	79.5	46.5	2.2	105.5	.5
5:15	10.2	89.8	79.6	46.5	2.2	105.5	.5
Average of 20 Readings.....			79.8	46.2	2.19	105.2	.5

Transmission—3.3 B. T. U.

Test No. 2 **Nonpareil Corkboard** April 24, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
7:30	10.1	90.0	79.9	45.5	2.15	103.5	.5
7:45	10.0	90.0	80.0	46.0	2.18	104.5	.5
8:00	10.0	90.0	80.0	46.0	2.18	104.5	.5
8:15	10.0	90.0	80.0	45.5	2.18	104.8	.5
8:30	9.8	89.5	79.7	46.0	2.18	104.5	.5
8:45	9.8	89.5	79.7	46.0	2.18	104.3	.5
9:00	10.0	89.5	79.5	46.0	2.18	104.8	.5
9:15	10.2	89.5	79.3	46.0	2.18	104.8	.5
9:30	10.3	89.5	79.2	46.0	2.18	104.3	.5
9:45	10.3	89.5	79.2	45.8	2.18	103.8	.5
10:00	10.3	89.5	79.2	45.8	2.18	103.5	.5
Average of 11 Readings.....			79.6	45.9	2.18	104.3	.5

Transmission—3.2 B. T. U.

Test No. 1 **Rock Cork** April 8, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
10:00	9.8	90.0	80.2	54.4	2.58	104.0	.5
10:15	10.0	90.0	80.0	54.0	2.58	104.0	.5
10:30	10.5	91.0	80.5	54.0	2.58	104.0	.49
10:45	10.8	91.0	80.2	50.5	2.4	104.0	.49
11:00	11.5	90.0	78.5	48.0	2.3	104.0	.49
11:15	11.3	89.8	78.5	48.0	2.3	104.0	.49
11:30	11.5	90.5	79.0	52.8	2.5	104.0	.49
11:45	11.4	90.5	79.1	52.8	2.5	104.0	.49
12:00	11.0	90.5	79.5	52.4	2.45	104.5	.48
3:15	9.5	90.0	80.5	49.0	2.35	105.8	.5
3:30	10.0	89.5	79.5	49.5	2.38	105.0	.49
3:45	10.0	90.0	80.0	51.6	2.45	105.5	.49
4:00	10.1	90.0	79.9	52.5	2.5	105.0	.49
4:15	10.2	90.0	79.8	52.6	2.5	105.5	.49
4:30	10.0	90.5	80.5	52.2	2.5	105.0	.48
4:45	10.0	90.5	80.5	51.8	2.45	106.5	.49
5:00	9.0	90.0	81.0	49.5	2.45	104.0	.48
Average of 17 Readings.....			79.8	51.5	2.46	104.6	.49

Transmission—**3.8** B. T. U.

Test No. 2 **Rock Cork** April 9, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
9:45	10.0	90.0	80.0	52.0	2.48	104.0	.49
10:00	9.8	90.5	80.7	51.8	2.4	103.5	.48
10:15	9.2	90.0	80.8	50.0	2.35	105.0	.49
10:30	9.0	90.0	81.0	48.5	2.3	104.5	.5
10:45	9.2	90.0	80.8	48.2	2.3	105.0	.49
11:00	10.0	90.0	80.0	48.0	2.28	104.0	.49
11:15	10.0	90.0	80.0	49.5	2.35	105.0	.48
11:30	10.0	90.0	80.0	49.0	2.33	104.5	.48
11:45	10.0	90.0	80.0	49.5	2.35	104.0	.48
12:00	9.8	90.0	80.2	50.0	2.38	106.0	.49
1:15	10.0	90.0	80.0	47.0	2.2	104.5	.5
1:30	9.7	90.0	80.3	51.0	2.4	104.5	.49
2:30	10.0	90.0	80.0	48.5	2.8	104.0	.48
2:45	10.0	90.0	80.0	48.0	2.38	104.5	.49
3:00	10.0	90.0	80.0	48.5	2.3	105.0	.48
3:15	10.0	90.0	80.0	50.0	2.35	105.5	.49
3:30	10.2	90.0	79.8	50.0	2.32	104.0	.50
3:45	10.5	90.0	79.5	49.0	2.35	104.0	.49
4:00	10.5	90.5	80.0	50.0	2.38	105.0	.49
4:15	10.2	90.0	79.8	48.5	2.3	104.5	.49
Average of 20 Readings.....			80.1	49.35	2.36	104.5	.49

Transmission—**3.6** B. T. U.

Test No. 1 **Lith** April 16, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
9:30	9.5	89.5	80.0	52.8	2.5	103.8	.5
9:45	9.8	89.5	79.7	54.0	2.55	103.5	.5
10:00	10.0	90.0	80.0	55.5	2.62	104.8	.49
10:15	10.2	90.0	79.8	55.5	2.6	103.5	.48
10:30	10.2	90.0	79.8	56.5	2.7	104.5	.49
10:45	10.0	90.5	80.5	56.0	2.65	103.5	.49
11:00	10.0	90.5	80.5	55.5	2.62	104.5	.50
11:15	10.0	90.0	80.0	54.5	2.58	104.0	.48
11:30	10.0	90.0	80.0	55.0	2.6	104.5	.5
11:45	10.0	90.0	80.0	55.2	2.65	105.0	.5
12:00	10.0	90.0	80.0	55.7	2.65	106.0	.5
2:00	10.0	90.0	80.0	55.0	2.63	105.5	.49
2:15	10.0	90.0	80.0	55.8	2.65	105.0	.49
2:30	10.5	90.0	79.5	55.0	2.62	106.0	.5
2:45	10.4	90.0	79.6	55.5	2.62	106.0	.5
3:00	10.2	90.0	79.8	55.5	2.62	105.5	.49
3:15	10.0	90.0	80.0	55.5	2.62	105.5	.5
3:30	9.8	90.0	80.2	55.2	2.62	105.0	.48
3:45	9.5	90.0	80.5	55.8	2.65	106.0	.5
4:00	9.5	90.0	80.5	55.5	2.65	105.5	.48
Average of 20 Readings.....			80.0	55.2	2.62	104.9	.49

Transmission—**4.0** B. T. U.

Test No. 2 **Lith** April 17, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
8:45	9.8	89.5	79.7	49.5	2.35	105.5	.5
9:00	10.0	90.0	80.0	53.5	2.58	105.0	.49
9:15	10.4	90.0	79.6	53.8	2.58	106.0	.5
9:30	10.5	89.5	79.0	53.5	2.55	105.0	.5
9:45	10.2	90.0	79.8	55.0	2.6	104.8	.5
10:00	10.0	90.0	80.0	55.0	2.6	105.5	.5
10:15	10.0	90.0	80.0	55.0	2.6	105.0	.5
10:30	10.0	90.0	80.0	54.5	2.6	105.5	.5
10:45	10.0	90.0	80.0	55.4	2.6	105.0	.5
11:00	10.0	90.0	80.0	55.0	2.6	105.0	.5
11:15	10.0	90.0	80.0	55.0	2.6	105.0	.5
11:30	9.8	90.0	80.2	55.0	2.6	105.0	.5
11:45	9.8	90.0	80.2	55.0	2.6	105.0	.5
Average of 13 Readings.....			79.9	54.2	2.57	105.2	.5

Transmission—**3.9** B. T. U.

Test No. 1 Waterproof Lith April 1, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
8:45	10.5	90.0	79.5	56.0	2.68	104.0	.5
9:00	10.2	90.0	79.8	55.0	2.6	103.0	.5
9:15	10.0	90.0	80.0	55.0	2.59	102.0	.5
9:30	10.0	90.0	80.0	55.0	2.59	102.3	.5
9:45	9.8	90.0	80.2	55.2	2.6	102.0	.5
10:00	9.7	90.0	80.3	55.0	2.6	102.0	.49
10:15	9.8	89.5	79.7	57.0	2.69	105.5	.5
10:30	9.8	90.0	80.2	57.0	2.69	104.8	.5
10:45	9.8	90.5	80.7	56.0	2.7	104.5	.5
11:00	9.9	90.3	80.4	56.0	2.62	104.0	.49
11:15	10.0	90.0	80.0	56.0	2.62	104.0	.5
11:30	10.4	90.0	79.6	56.0	2.62	104.0	.5
11:45	11.5	90.5	79.0	56.0	2.62	103.0	.49
12:00	11.0	90.0	79.0	55.0	2.62	100.5	.48
1:45	10.0	90.0	80.0	56.0	2.65	104.0	.5
2:00	11.0	90.0	79.0	56.8	2.68	104.0	.49
2:15	11.5	90.0	78.5	56.0	2.62	104.0	.49
2:30	11.5	90.0	78.5	55.0	2.6	102.0	.49
2:45	11.5	90.0	78.5	56.8	2.7	105.0	.49
3:00	11.2	91.0	79.8	57.0	2.7	106.0	.5
3:15	10.1	91.0	80.9	54.9	2.6	105.0	.49
3:30	10.0	91.0	81.0	55.3	2.68	104.5	.5
3:45	8.9	90.0	81.1	53.2	2.5	105.0	.5
4:00	8.1	89.0	80.9	53.5	2.5	105.0	.5
4:15	8.4	90.0	81.6	56.5	2.7	104.0	.5
Average of 25 Readings.....			80.0	55.65	2.63	103.8	.5

Transmission—4.2 B. T. U.

Test No. 2 Waterproof Lith April 2, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
9:30	9.5	90.0	80.5	56.0	2.7	104.0	.49
9:45	9.5	90.5	81.0	56.8	2.65	103.0	.49
10:00	9.5	90.0	80.5	57.0	2.7	103.0	.49
10:15	9.5	90.0	80.5	55.0	2.6	102.0	.49
10:30	10.1	90.0	79.9	56.0	2.6	103.5	.49
10:45	10.3	90.0	79.7	55.0	2.6	103.5	.49
11:00	10.8	90.0	79.2	55.5	2.6	103.5	.49
11:15	12.0	90.0	78.0	56.0	2.68	104.0	.49
11:30	11.0	90.0	79.0	56.0	2.65	104.0	.5
11:45	9.5	90.0	80.5	56.0	2.65	106.0	.5
2:00	10.0	91.0	81.0	59.0	2.8	104.0	.49
2:15	10.0	91.0	81.0	53.5	2.5	103.5	.49
2:30	9.8	90.0	80.2	53.5	2.5	103.5	.49
2:45	10.0	91.0	81.0	57.0	2.7	104.8	.5
3:00	10.2	90.0	79.8	55.0	2.65	105.0	.5
3:15	10.4	90.0	79.6	55.0	2.6	105.0	.5
Average of 16 Readings.....			80.1	55.8	2.64	103.9	.5

Transmission—4.2 B. T. U.

Test No. 1 **Composition Corkboard** May 6, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
9:30	10.0	90.0	80.0	57.4	2.76	105.5	.5
9:45	10.0	90.0	80.0	57.0	2.75	105.0	.5
10:00	10.0	90.0	80.0	57.5	2.75	105.5	.5
10:15	10.0	90.0	80.0	57.2	2.75	104.0	.5
10:30	10.0	90.0	80.0	58.0	2.75	105.0	.5
10:45	10.0	90.0	80.0	58.5	2.78	105.5	.5
11:00	10.2	90.5	80.3	58.0	2.78	106.5	.5
11:15	10.5	90.5	80.0	57.5	2.75	107.0	.5
11:30	10.2	90.0	79.8	55.5	2.68	105.0	.5
11:45	10.0	89.5	79.5	55.5	2.65	105.0	.5
2:30	9.5	89.5	80.0	57.5	2.75	105.5	.5
2:45	9.8	89.5	79.7	57.8	2.78	105.5	.5
3:00	10.0	90.0	80.0	58.0	2.78	106.0	.5
3:15	10.0	90.0	80.0	58.0	2.78	106.0	.5
3:30	10.0	90.0	80.0	57.5	2.75	105.0	.5
3:45	10.0	90.0	80.0	58.5	2.78	106.0	.5
4:00	10.0	90.0	80.0	58.0	2.78	106.5	.5
4:15	10.0	90.5	80.5	57.5	2.78	106.8	.5
4:30	10.0	90.0	80.0	56.2	2.7	106.8	.5
4:45	10.2	90.0	79.8	57.0	2.72	107.0	.5
Average of 20 Readings.....			80.0	57.4	2.75	105.75	.5

Transmission—4.5 B. T. U.

Test No. 2 **Composition Corkboard** May 7, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
8:45	10.3	90.5	80.2	56.0	2.7	104.5	.5
9:00	10.2	90.0	79.8	57.0	2.7	106.0	.5
9:15	10.2	90.5	80.3	58.2	2.78	107.0	.5
9:30	10.2	90.2	80.0	57.0	2.72	107.5	.5
9:45	10.2	90.0	79.8	55.5	2.68	105.5	.5
10:00	10.2	89.5	79.3	56.0	2.72	107.2	.5
10:15	10.2	90.0	79.8	57.8	2.78	106.5	.5
10:30	10.2	90.5	80.3	58.0	2.75	107.0	.5
10:45	10.1	90.5	80.4	57.0	2.72	105.2	.5
11:00	10.0	90.5	80.5	57.3	2.72	105.0	.5
11:15	10.0	90.5	80.5	57.5	2.72	106.0	.5
11:30	10.0	90.5	80.5	57.0	2.72	105.0	.5
11:45	10.0	90.5	80.5	57.0	2.72	106.5	.5
12:00	10.0	90.5	80.5	57.0	2.72	105.5	.5
12:15	10.0	90.5	80.5	56.5	2.72	105.5	.5
Average of 15 Readings.....			80.2	57.0	2.72	106.0	.5

Transmission—4.4 B. T. U.

Test No. 1 **Indurated Fibre** April 13, 1909

TIME	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
7:30	9.8	89.5	79.7	61.2	2.9	105.0	.49
7:45	9.3	90.0	80.7	62.5	2.95	105.0	.48
8:00	9.0	90.0	81.0	63.0	2.98	105.5	.48
8:15	9.0	90.0	81.0	63.4	3.0	106.0	.48
8:30	9.4	90.5	81.1	62.5	2.95	106.0	.49
8:45	10.0	90.0	80.0	61.0	2.9	105.0	.49
9:00	10.0	89.5	79.5	61.2	2.9	105.2	.48
9:15	10.0	90.0	80.0	61.8	2.9	105.0	.48
9:30	10.0	90.0	80.0	61.0	2.9	104.0	.48
9:45	9.8	89.0	79.2	61.0	2.9	103.8	.49
10:00	9.8	89.5	79.7	62.5	2.98	105.0	.49
10:15	10.0	90.0	80.0	62.2	3.0	106.0	.49
10:30	10.2	90.0	79.8	62.8	2.9	105.0	.48
10:45	10.2	90.0	79.8	62.3	2.95	104.5	.49
11:00	10.1	90.0	79.9	62.5	2.95	104.8	.48
11:15	10.0	90.0	80.0	62.3	2.93	104.5	.48
11:30	10.0	90.0	80.0	62.8	2.95	105.2	.48
11:45	10.0	90.0	80.0	62.5	2.95	104.8	.49
12:00	10.0	90.0	80.0	62.5	2.95	105.0	.49
Average of 19 Readings.....			80.0	62.2	2.94	105.0	.485

Transmission—**5.0** B. T. U.

Test No. 2 **Indurated Fibre** April 14, 1909

TIME	T. I Degrees F.	T. 2 Degrees F.	D Degrees F.	COIL		FAN	
				Volts	Amp.	Volts	Amp.
8:30	9.5	89.5	80.0	61.5	2.9	104.0	.48
8:45	10.0	89.5	79.5	62.0	2.93	104.5	.49
9:00	10.4	90.0	79.6	64.5	3.5	104.5	.48
9:15	10.5	90.5	80.0	64.0	2.9	104.0	.49
9:30	10.5	90.5	80.0	64.5	2.9	104.5	.49
9:45	10.0	90.0	80.0	62.0	2.9	105.5	.48
10:00	9.8	90.5	80.7	62.5	2.95	105.0	.49
10:15	9.5	90.0	80.5	61.0	2.88	105.0	.48
10:30	9.2	90.0	80.8	61.5	2.9	104.5	.49
10:45	9.8	90.0	80.2	61.5	2.9	106.0	.49
11:00	10.0	90.0	80.0	62.0	2.95	106.0	.49
11:15	10.2	90.0	79.8	62.0	2.9	105.0	.49
11:30	10.0	90.0	80.0	62.0	2.92	104.5	.49
11:45	10.0	90.0	80.0	62.0	2.9	105.0	.48
12:00	9.8	90.0	80.2	62.0	2.9	105.8	.49
12:15	9.5	90.0	80.5	62.0	2.9	105.2	.49
12:30	9.5	90.0	80.5	62.0	2.9	105.5	.49
12:45	9.8	90.0	80.2	62.0	2.95	106.0	.49
1:00	10.0	90.0	80.0	62.8	2.94	106.0	.49
Average of 19 Readings.....			80.1	62.3	2.94	105.1	.487

Transmission—**5.0** B. T. U.

The results of the tests are as follows, the materials being arranged in order of merit:

Material	Date	Temp. Dif. Deg. F.	Coil		Fan		Mean Area Sq. Ft.	Trans. in B. T. U.'s for 2-in. thickness per sq. ft. per deg. difference in temp. per 24 hrs.
			Volts	Amp.	Volts	Amp.		
1. Nonpareil Corkboard								
Test No. 1.....	4/23	79.8	46.2	2.19	105.2	.5	48.0	**3.3**
" " 2.....	4/24	79.6	45.9	2.18	104.3	.5	48.0	**3.2**
2. Rock Cork								
Test No. 1.....	4/8	79.8	51.5	2.46	104.6	.49	48.0	**3.8**
" " 2.....	4/9	80.1	49.35	2.36	104.5	.49	48.0	**3.6**
3. Lith								
Test No. 1.....	4/16	80.0	55.2	2.62	104.9	.49	50.12	**4.0**
" " 2.....	4/17	79.9	54.2	2.57	105.2	.5	50.12	**3.9**
4. Waterproof Lith								
Test No. 1.....	4/1	80.0	55.65	2.63	103.8	.5	48.0	**4.2**
" " 2.....	4/2	80.1	55.8	2.64	103.9	.5	48.0	**4.2**
5. Composition Corkboard								
Test No. 1.....	5/6	80.0	57.4	2.75	105.75	.5	48.0	**4.5**
" " 2.....	5/7	80.2	57.0	2.72	106.0	.5	48.0	**4.4**
6. Indurated Fibre								
Test No. 1.....	4/13	80.0	62.2	2.94	105.0	.485	48.0	**5.0**
" " 2.....	4/14	80.1	62.3	2.94	105.1	.487	48.0	**5.0**

Since it has been well established that the transmission through any insulating material of uniform structure varies inversely as its thickness, on the basis of my tests, I find that the heat transmission through these several materials per square foot, per degree difference in temperature, per twenty-four hours, for one inch thickness, is:

Nonpareil Corkboard -	**6.5 B. T. U.**
Rock Cork	**7.4** "
Lith	**7.9** "
Waterproof Lith	**8.4** "
Composition Corkboard	**8.9** "
Indurated Fibre	**10.0** "

It is interesting to note that Waterproof Lith is not as efficient as the old type of Lith.

The foregoing results show that

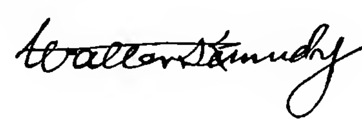
Nonpareil	Corkboard	is	12.2 %	more	efficient	than	Rock Cork
"	"	"	17.7 %	"	"	"	Lith
"	"	"	22.6 %	"	"	"	Waterproof Lith
"	"	"	27.0 %	"	"	"	Composition Corkboard
"	"	"	35.0 %	"	"	"	Indurated Fibre

or, in other words, that

Rock Cork	is	13.8 %	less	efficient	than	Nonpareil	Corkboard
Lith	"	21.5 %	"	"	"	"	"
Waterproof Lith	"	29.2 %	"	"	"	"	"
Composition Corkboard	"	36.9 %	"	"	"	"	"
Indurated Fibre Board	"	53.8 %	"	"	"	"	"

I desire to call particular attention to the fact that the figures above show not merely the relative value as heat insulators of these several materials. They do more than this; they give actual transmission, and hence can be put to practical use in designing insulation on a scientific basis. It has been gratifying to me to note how closely the results that I have obtained approximate those previously determined by your own engineers in a series of experiments extending over several years.

Yours truly,



RESULTS OF TESTS

At this plant a long series of tests has been made by our own engineers, not only on insulating materials but also on building

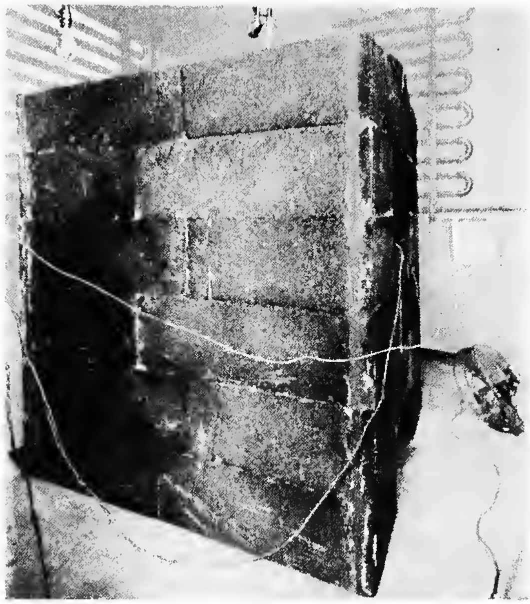
Test Box Built of Brick, Thirteen Inches in Thickness.

materials, such as brick and concrete. With the data thus obtained, the heat loss through any type of construction can be computed accurately, and the proper thickness of insulation to install determined on a thoroughly scientific basis. The following table gives some of the results:

Material	Thickness	Transmission in B. T. U. per sq. ft. per deg. F. diff. in temp. for 24 hours	Transmission in B. T. U. per sq. ft. per deg. F. diff. in temp. per 1 in. thickness for 24 hrs.	Date
Nonpareil Corkboard..	1 inch	6.4	6.4	Sept. 6, 1907
" "	1 "	6.4	6.4	Oct. 2, 1907
" "	1 "	6.2	6.2	Oct. 3, 1907
" "	1 "	6.2	6.2	Oct. 4, 1907
" "	2 "	3.0	6.0	Nov. 6, 1907
" "	2 "	3.0	6.0	Nov. 7, 1907
" "	2 "	2.9	5.8	Nov. 8, 1907
" "	2 "	3.0	6.0	Nov. 13, 1907
" "	2 "	2.9	5.8	Nov. 14, 1907
" "	2 "	3.0	6.0	Nov. 15, 1907
* " "	2 "	3.3	6.6	April 23, 1909
* " "	2 "	3.2	6.4	April 24, 1909
" "	3 "	2.2	6.6	June 7, 1907
" "	3 "	2.2	6.6	June 22, 1907
		Average of 14 Tests, 6.2		
Composition Corkboard (Granulated cork and asphalt)..	2 inch	4.2	8.4	July 26, 1907
	2 "	4.5	9.0	July 30, 1907
	*2 "	4.5	9.0	May 6, 1909
	*2 "	4.4	8.8	May 7, 1909
		Average of 4 Tests, 8.8		
Lith	2 inch	3.8	7.6	Oct. 16, 1907
"	2 "	3.7	7.4	Oct. 17, 1907
"	2 "	3.7	7.4	Oct. 18, 1907
"	2 "	3.8	7.6	Oct. 30, 1907
"	2 "	3.8	7.6	Oct. 31, 1907
* "	2 "	4.0	8.0	April 16, 1909
* "	2 "	3.9	7.8	April 17, 1909
		Average of 7 Tests, 7.6		
*Waterproof Lith	2 inch	4.2	8.4	April 1, 1909
* " "	2 "	4.2	8.4	April 2, 1909
		Average of 2 Tests, 8.4		
*Rock Cork	2 inch	3.8	7.6	April 8, 1909
* " "	2 "	3.6	7.2	April 9, 1909
		Average of 2 Tests, 7.4		
*Indurated Fibre	2 inch	5.0	10.0	April 13, 1909
* " "	2 "	5.0	10.0	April 14, 1909
		Average of 2 Tests, 10.0		
4-inch Cork Concrete (Patented) mixed 6 parts Unscreened Granulated Cork to 1 part of Portland cement, with ½-inch Portland cement plaster on both sides	5 inch	4.8	24.0	Sept. 10, 1908
	5 "	4.7	23.5	Sept. 11, 1908
	5 "	4.8	24.0	Oct. 22, 1908
		Average of 3 Tests, 23.8		

Material	Thickness	Transmission in B. T. U. per sq. ft. per deg. F. diff. in temp. for 24 hours	Transmission in B. T. U. per sq. ft. per deg. F. diff. in temp. per 1 in. thickness for 24 hrs.	Date
3-inch Cork Concrete (Patented) mixed 8 parts Unscreened Granulated Cork to 1 part of Portland cement, with ½-inch Portland cement plaster on both sides	4 inch	4.1	16.4	Mar. 17, 1909
	4 "	4.1	16.4	Mar. 17, 1909
Average of 2 Tests, 16.4				
1-inch Nonpareil Corkboard with ½-inch Portland cement plaster	1½ inch	5.9	...	Dec. 5, 1907
	1½ "	5.8	...	Dec. 6, 1907
Average of 2 Tests, 5.85				
Brick Wall	13 inch	8.8	114.4	April 10, 1908
" "	13 "	9.5	123.5	April 24, 1908
" "	13 "	9.4	122.2	April 25, 1908
Average of 3 Tests, 120.0				
13-inch Brick Wall insulated with one layer of 2-inch Nonpareil Corkboard erected in ½-inch Portland cement ...	15½ inch	2.7	....	May 21, 1908
	15½ "	2.8	....	May 22, 1908
Average of 2 Tests, 2.75				
13-inch Brick Wall insulated with two layers 2-inch Nonpareil Corkboard each erected in ½-inch Portland cement...	18 inch	1.5	....	June 16, 1908
	18 "	1.4	....	Aug. 8, 1908
Average of 2 Tests, 1.45				
Concrete (1-3-5)	4 inch	25.5	102.0	April 30, 1909
" "	4 "	26.0	104.0	May 1, 1909
Average of 2 Tests, 103.0				

*Tests made by Walter Kennedy, M. E., Pittsburgh, Pa.



Thirteen-Inch Brick Test Box, insulated with two-inch Nonpareil Corkboard laid up in one-half inch Portland cement mortar.

II. The Moisture Resisting Capacity of Nonpareil Corkboard.

While efficiency as a nonconductor of heat is obviously of the utmost importance in an insulating material, durability in actual service is just as essential, and durability in this connection, translated into the simplest terms, means merely the ability to resist moisture. Water is a good conductor of heat; hence, just as soon as any insulating material gets water-soaked, it becomes practically worthless as an insulator. Moreover, moisture causes rapid deterioration in the insulating material itself. Therefore, thoroughly durable insulation must be waterproof in every sense of the word. When put to this test, practically all the materials that, in a dry state, are good nonconductors of heat, may be weighed

MOISTURE AND DURABILITY

in the balance and found wanting. But here again Nonpareil Corkboard asserts its superiority. It will not become waterlogged. Its tiny sealed air cells will not absorb moisture

THE GOVERNMENT MOISTURE TEST ON NONPAREIL CORKBOARD Take a piece of Nonpareil Cork that has been soaked in water, cut it open and you will find it dry inside. Or, if you prefer to do so, you can make a simple test yourself, which will demonstrate conclusively that Nonpareil Corkboard is the only form of insulation *that will keep itself dry.* In making this test, you will be following the example of the United States Navy Department. Large quantities of Nonpareil Corkboard are used aboard battleships and cruisers to insulate magazines, refrigerated rooms and living quarters, the government specifications providing that all corkboard used must withstand boiling for three hours at atmospheric pressure without going to pieces and without expanding more than two per cent in any direction.

Boiling Test on Nonpareil Corkboard.

Break your sample of Nonpareil Corkboard in half and boil one piece for three hours. Weight it down, if you wish, so as to submerge it completely. Then break the granules open and you will find them dry as a bone inside. By fitting the dry

piece against the other, it will be seen that the boiled part remains firm and has not expanded appreciably. Try the same experiment with any other kind of corkboard, mineral wool block or wood pulp board, and draw your own conclusions.

CONDENSATION

When a cold storage room is cooled down, the air confined in the insulation on the side next to the room gets cold and contracts. This produces a partial vacuum and the warm air outside endeavors to force its way in to restore equilibrium. It carries with it, of course, more or less moisture, which, when the air is cooled below the dew point, condenses and is deposited right in the heart of the insulation itself. This goes on, not at one moment but constantly, day and night, during the whole time the plant is in use and unless the insulation is absolutely waterproof, it will soon reek with moisture.

CAPILLARY ATTRACTION

This process is materially aided and hastened by the capillary attraction of all types of insulation of fibrous character, i. e., mineral wool, hair felt, wood pulp, flax fibre, shavings, sawdust, boards and air space construction, etc. They all literally suck in moisture from the outer air, no matter how carefully the attempt is made to render them waterproof by impregnating them with oil, by coating them with pitch or asphalt, or by lining the walls with insulating paper. Sooner or later the warm air

will effect an entrance somewhere, condensation will begin, and before long the insulation will become water-soaked, rotten and inefficient. Eventually it will have to be torn out and replaced.

Boards and Air Space Insulation. Rotted out after only six years' service in a Philadelphia abattoir.

NONPAREIL CORKBOARD MOISTURE PROOF

Nonpareil Corkboard, on the contrary, will last as long as the building itself. The warm air cannot penetrate its tiny air cells, for nature herself seals them up hermetically, completely isolating each one from the myriads of others. Every granule of cork,

moreover, is covered with a waterproof coating of the natural gum, liquified and brought to the surface by the manufacturing process. Hence, there is absolutely no capillary attraction, no absorption of moisture, no progressive deterioration at all. Nonpareil Corkboard is practically everlasting.

Section of Nonpareil Corkboard Insulation after four years' service, taken from one of Swift & Company's coolers, Philadelphia, Pa., on account of alterations in the building. The insulation, as shown, consisted of one course of two-inch and one of one-inch Nonpareil Corkboard, both erected in Portland cement mortar, with Portland cement plaster finish. On its removal, the corkboard was found to be in as dry and perfect condition as the day it was put in.

III. Nonpareil Corkboard Keeps Free from Rot, Mold and Offensive Odors.

DANGER OF TAINT

Everyone knows how susceptible delicate food stuffs, such as milk, cream, butter, eggs, ice cream, etc., are to any marked odor; and how essential it is that they be stored only under thoroughly sanitary and hygienic conditions. The insulation of every storage room, in which such goods are carried, should, therefore, be practically odorless to begin with; and in the second place, should be proof against rot, mold and the offensive odors generated by decay. For the first reason, the use of cheap corkboard, in which pitch serves as the binder, is apt to result disastrously. Tainting is almost sure to follow its installation, for the odor of pitch is particularly penetrating. Nor should hair felt, or any other animal substance be employed, for it inevitably gets damp, decays and becomes exceedingly offensive. Boards and air space construction, shavings, sawdust, cotton seed hulls, etc., mold and soon rot out. All such types of insulation, moreover, afford excellent harboring places for rats, mice and other vermin; render the maintenance of hygienic and sanitary conditions impossible, and largely increase the danger of fire.

HARBORING PLACES FOR VERMIN

Nonpareil Corkboard, on the other hand, will not rot, mold, or give off offensive odors. Properly erected, it is vermin proof. Rooms insulated with it, with Portland cement plaster finish, are easily kept in sanitary and hygienic condition. They may be washed down with a hose in fact, as often as necessary,

NONPAREIL CORKBOARD ENSURES SANITARY CONDITIONS

without affecting the insulation in the slightest. This last point is of great importance where citrus fruits, or anything else that gives off a marked odor, are handled. In such cases, it is absolutely necessary that the storage rooms be entirely freed of the odor before other goods are placed therein; otherwise, tainting is sure to take place. To accomplish this speedily is frequently very difficult, but with Nonpareil Corkboard insulation, the objectionable condition can be readily and promptly overcome.

The recent pure food legislation demands the maintenance of a high standard in the manufacture and distribution of food products—a higher standard than has generally prevailed in the past. Although practically all the industries in which refrigeration is used have felt the effects of such legislation, the fact that Nonpareil Corkboard ensures and renders easy the maintenance of sanitary and hygienic conditions, is of particular importance to the dairyman, the creamery man, the baker, the candy maker, the ice cream manufacturer and the cold storage warehouseman.

IV. The Slow Burning and Fire Retarding Properties of Nonpareil Corkboard.

Nonpareil Corkboard is first, slow burning, as ignited cork will not support combustion in the absence of heat applied from some external source; and second, fire retarding, since the solid and compact construction that it permits, unlike old methods, leaves no concealed air spaces in the walls to act as flues and assist in the spread of a fire once under way.

APPROVED BY THE NATIONAL BOARD OF FIRE UNDERWRITERS

It has the enviable distinction of being the only cold storage insulating material that is approved by the National Board of Fire Underwriters. Approval was given only after an exhaustive test conducted by the Underwriters Laboratories, Inc., Chicago, Ill., on November 7, 1907. A section of wall insulated with two courses of two-inch Nonpareil Corkboard, both erected in Portland cement mortar, with a Portland cement plaster finish, not only withstood intense heat, running as high as 2240° F., for one hour, but also a stream of water thrown against it at high pressure at the expiration of that time. The elaborate report describing this test in detail is on file in the offices of the National Board of Fire Underwriters in the following cities, and may be consulted on application: New York, Boston, Philadelphia, Newark, N. J., Syracuse, N. Y., Hartford, Conn., Chicago, St. Louis, New Orleans, Atlanta, San Francisco.

The Type of Construction Approved by the Underwriters.

THE UNDERWRITERS' REPORT

The official summary and approval, a synopsis of the detailed report, is given in full below. It may be found on file in the offices of all the underwriters associations, fire insurance companies, and agencies who are subscribers to the National Board of Fire Underwriters:

191—March 4, 1908.

Heat Insulating Coverings.

Armstrong Cork Company, Manufacturers,

Pittsburgh, Pa.

Corkboard (Nonpareil) Laid in Cement Mortar.

Heat insulating covering for walls, floors and ceilings (not for steam pipes, stacks, etc.), of two-ply construction, consisting of two layers of 2-inch Nonpareil Corkboard bedded in ½-inch layers of cement mortar and covered with a ½-inch finish coating of the same material.

Corkboard in sizes not exceeding 36 x 12 inches laid with joints broken in both directions. Cement mortar made of one part Portland cement and two parts clean, sharp sand.

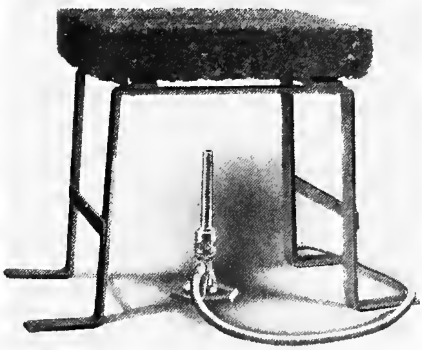
Corkboard for floors laid in hot asphalt and covered with concrete 3 to 4 inches thick.

The above is APPROVED for heat insulating purposes for walls, floors and ceilings in cold storage warehouses, cold storage cellars in breweries, cold rooms in packing houses, hotel refrigerators, fur storage rooms and rooms of this character.

(Underwriters having jurisdiction to be consulted before installation).

REDUCED INSURANCE RATES

The approval of the Underwriters results in reduced insurance rates, not only on buildings, but their contents as well.



Apparatus for Simple Fire Test.

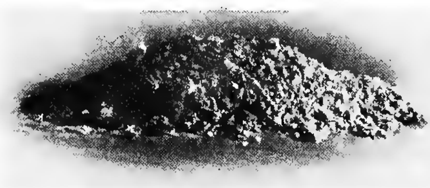
Anyone can readily determine the relative slow burning qualities of Nonpareil Corkboard as compared with other forms of insulation by a simple experiment. All that is needed is an iron stand, a burner, and pieces of the different materials, say, twelve inches square and two inches thick. Place each piece on the stand, as indicated in the accompanying illustration; record the time it takes to burn a hole clear through, and carefully note the condition of each specimen at the expiration of this period. The cut on this page shows the appearance of a piece of Nonpareil Corkboard after a 1500° F. flame had been burning under it for four hours and five minutes. It took just that long for the

A SIMPLE EXPERIMENT

Two-inch Nonpareil Corkboard after 1500° F. flame had been applied for four hours and five minutes.

flame to burn through. Notice that it did not spread out or char the under surface.

The other picture shows what was left of a piece of fibrous compressed mineral wool block of the same size and thickness after the same flame had been applied for but two hours and five minutes. When lifted from the stand it simply fell to pieces. If you will also test wood pulp board, and the other forms of corkboard on the market, you will readily appreciate why the Underwriters have given their approval to Nonpareil Corkboard and to no other type of cold storage insulation.



Fibrous Compressed Mineral Wool Block after 1500° F. flame had been applied for two hours and five minutes.

A REMARKABLE FIRE TEST

The results of an elaborate test made at Beaver Falls, Pa., on August 24, 1907, demonstrate in striking fashion its fire retarding properties. A room eight feet square and eight feet high was constructed of two by four-inch studs, sheathed on the inside with ordinary one-inch lumber. The walls and ceiling were insulated with two courses of two-inch Nonpareil Corkboard, both erected in Portland cement with one-half inch Portland cement plaster finish.

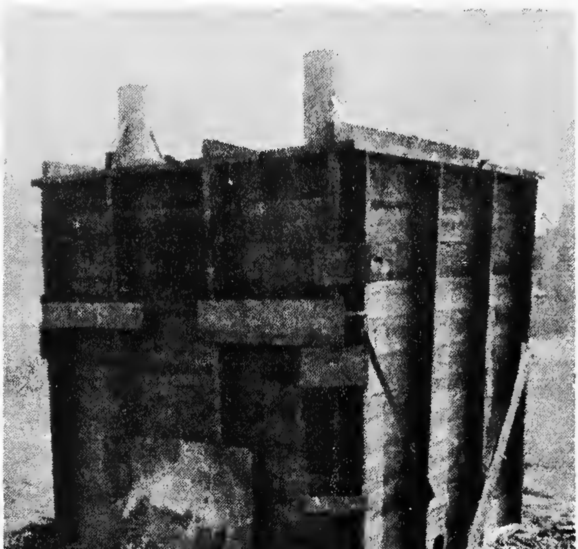
After the cement had thoroughly dried, the room was filled with a mass of combustible material—firewood, kerosene, etc. Several small holes around the base and the opening through which the fuel was supplied, allowed the free

ingress of air. As shown in the photographs, there were four flues, eight inches in diameter, one at each corner of the roof. The duration of the test was two hours. By means of a thermo-electric pyrometer, the temperature at two widely separated points inside the room was recorded at five minute intervals. The maximum temperature

Insulated Room Before the Test.

reached was 1937° F., but the outside of the walls never became heated. To the touch they were as cool at the end as at the beginning of the test. Finally the fire was extinguished by a stream of water thrown with considerable force not only on the mass of burning material but also on the walls and ceiling.

The Fire at its Height.



The Insulated Room at the Conclusion of the Test

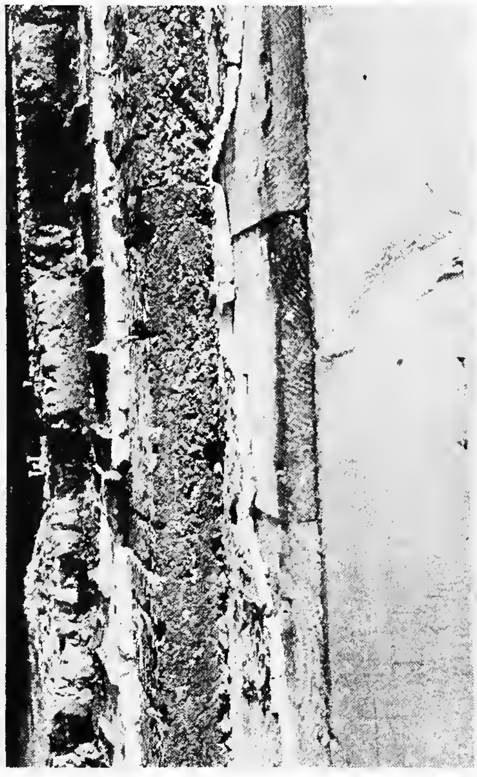
THE RESULTS Examination revealed that the cement plaster had all fallen down, with the exception of a small amount around the edges of the walls and ceiling. The outer course of corkboard had been charred almost all the way through but still remained clinging to the cement mortar between the two layers. The fire had carbonized

After the Test. The front of the test room torn away, showing corkboard still firmly attached to the walls and ceiling.

the cork and the layer of carbon, itself a good insulator, had shielded the part beneath. The cement mortar between the two layers and the under course of corkboard were not affected in any way. The pictures of the room after the test, the front having been torn away, and a cross-section of one of the walls at close range,

verify the truth of this assertion. A complete report of this test will be mailed on request.

ACTUAL FIRES Nor are demonstrations of what our corkboard will do in actual fires lacking. The only thing, in the opinion of the architect and



Cross Sectional View of Wall of Room after the Test, showing from right to left—studding, sheathing, cement back, under course of corkboard, the cement between, and outer layer of corkboard shriveled by the heat.

the fire insurance adjusters, that saved the walls of the cold storage building of the Zoller Packing Company, Allegheny, Pa., when the rest of the plant was destroyed in April, 1907, was the two layers of two-inch corkboard insulation. Success-

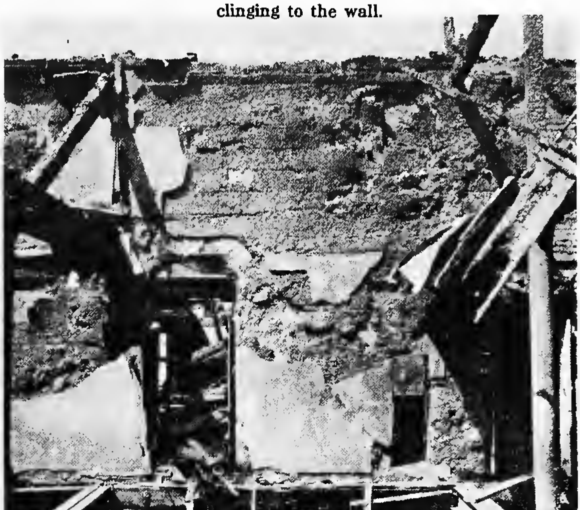
fully withstanding the intense heat generated by thousands of pounds of lard and other combustible materials, the corkboard remained clinging to the walls, preventing the flames from reaching the brick, calcining them and thus causing utter collapse. As it was, while the whole of the interior

Zoller Packing Company's Cold Storage Building after the Fire. The interior was completely gutted, as shown by the two views following.

of the building was burned out, the four walls remained intact. When the plant was rebuilt, they were utilized again, together with almost all of the under course of corkboard, which was undamaged. A complete description of this fire will be forwarded on application.

In a number of other plants also, corkboard has proved its efficacy as a fire retardant; viz.,

Zoller Packing Company. Interior view of wall of cold storage building, the exterior of which is shown in the first photograph. The corkboard may be seen clinging to the wall.



Zoller Packing Company. Interior of cold storage building completely gutted. The corkboard may be seen still firmly attached to the wall.

Arbogast & Bastian, Allentown, Pa., Abraham & Straus, fur vault, Brooklyn, N. Y., Hazelwood Cream Company, Portland, Oregon, and Ridgway Pure Ice Company, Ridgway, Pa.

V. The Structural Strength of Nonpareil Corkboard and the Ease with which it May be Erected.

The structural strength of Nonpareil Corkboard and the ease with which it may be erected are two of the strongest points in its favor. It may be cut, sawed and nailed into place just as lumber in buildings of frame construction, or put up with equal readiness in Portland cement mortar against brick, stone, concrete, or hollow tile walls and ceilings. It requires no external support or retaining walls to hold it in place. Solid Nonpareil Corkboard partitions as high as fifteen feet are readily erected without the use of any studding whatsoever. They save space and the cost of lumber otherwise required. In insulating floors and the bottoms of freezing tanks, Nonpareil Corkboard is laid down in asphalt. Its strength in compression is ample to take care of loads many times greater than those ordinarily encountered. Portland cement plaster adheres perfectly to its surface, affording a thoroughly sanitary and hygienic finish.

STRONG AND EASILY ERECTED

OTHER CORKBOARD STRUCTURALLY WEAK

All this cannot be said about other types of insulation in sheet form. Those forms of corkboard in which glue, asphalt, or pitch is used as a binder (except Genuine German

Impregnated Corkboard, see page 104) are apt to loosen up in time, particularly when applied against wooden ceilings. The weight of the plaster and the corkboard itself tends to pull the nails through the sheets, the corkboard dropping away, leaving the nails sticking in the sheathing. In Nonpareil Corkboard, the natural gum or rosin of the cork itself serves to bind the whole mass

Erecting two courses of Nonpareil Corkboard against Studding, using Waterproof Insulating Paper.

together securely. This natural binder is proof against moisture, acids and alkalies. Hence the board will not disintegrate, and as it is firm and tough, it can be nailed against ceilings with the assurance that the nail heads will not pull through.

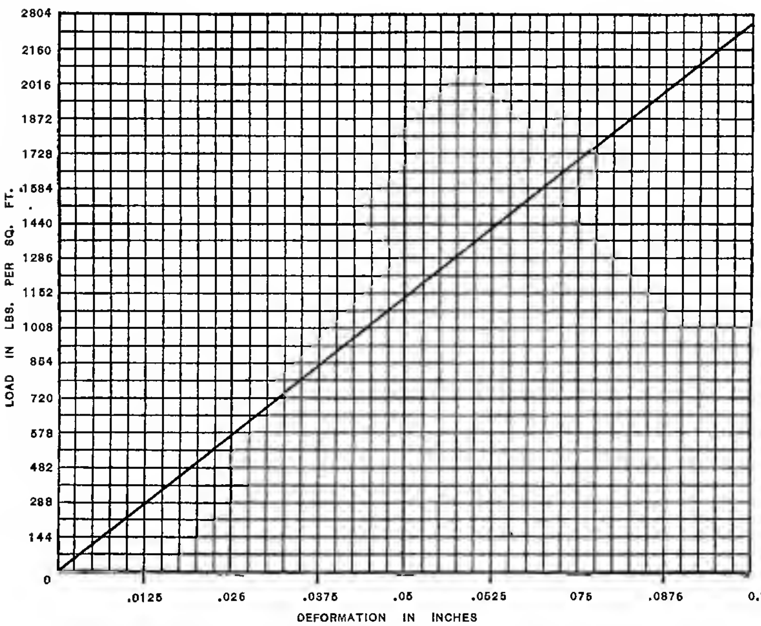
MINERAL WOOL BLOCKS UNSTABLE

The difficulties met with in handling mineral wool boards are many. To begin with, the material itself is unstable and requires the admixture of some fibrous binder to give it any structural strength at all. It cannot be erected with Portland cement satisfactorily, as each block must first be coated with asphalt to waterproof it, and the bond which results between the surface

Erecting two courses of three-inch Nonpareil Corkboard in Portland Cement against brick wall in the Morris Cold Storage Company's plant, Chicago, Ill. Insulated concrete column may be seen at the left.

covered with asphalt and Portland cement is not of sufficient strength. Mineral wool blocks, therefore, have to be laid up against brick walls in asphalt or pitch, which not only adds to the risk in case of fire, but also is not nearly so durable a type of construction as that afforded by Portland cement. When nailed against studding or sheath-

ing, roofing washers or large pieces of expanded metal lath have to be used about the heads of the nails, to prevent them from pulling through. It is a very disagreeable material to handle, as the fine particles get into the hands and even into the nose, eyes and lungs, causing serious irritation.



Compression Test on Nonpareil Corkboard made by Pittsburgh Testing Laboratories, Pittsburgh, Pa. Size of tested specimen 10 inches x 10 inches x 2 inches thick, tested flat. April 1st, 1907.

RELATIVE STRUCTURAL STRENGTH

To test the relative structural strength of Nonpareil Corkboard and mineral wool block is a very simple matter. Lay a sheet of each up against a wall in Portland cement mortar and after the cement dries, try pulling the boards down. When you get through, no doubt will be left in your mind as to which gives the stronger and more substantial job.

In insulating concrete or hollow tile ceilings, Nonpareil Corkboard is laid up in a bed of Portland cement mortar. In the case of concrete structures, however, it is frequently laid down in the ceiling forms, which are made correspondingly deeper, and the concrete poured in on top. After the forms are removed, cement plaster is applied to the exposed surface of the cork. The strength

Concrete Ceiling insulated with Nonpareil Corkboard erected in Portland Cement. Merchants Ice & Cold Storage Company's Plant, Cincinnati, Ohio.

of the bond between Nonpareil Corkboard and concrete is remarkable, as the following test, made in Pittsburgh in June, 1907, gives evidence:

TEST OF BOND BETWEEN NONPAREIL CORKBOARD AND CONCRETE

Two pieces of three-inch Nonpareil Corkboard, each measuring twelve inches by eighteen inches, were used. Grooves were made in one side of each board, so as to

permit two iron bars, five and a quarter inches (center to center) apart, running lengthwise, to lie flush with its surface. In these bars, which were one and a quarter inches wide, three-eighths inches thick, and eighteen inches long, two holes were drilled and tapped nine inches apart. Corresponding holes were made in the corkboard so that hooks might be screwed into the bars from

Insulating Concrete Ceiling by laying down Nonpareil Corkboard in the ceiling forms before concrete was poured in. Merchants Ice & Cold Storage Company's Plant, Cincinnati, Ohio.

beneath. By this means the load was distributed over the entire area of contact between the cork and the concrete, when weights were attached to the hooks. The corkboard was then laid on a false ceiling and four inches of concrete placed upon it, the concrete being composed of one part of Portland cement, three parts clean, sharp sand, and five of

crushed stone. After it had thoroughly set for twenty days, the hooks were screwed into the bars and weights added gradually. Two tests showed that it required an average of 344 pounds per square foot to break the bond between the corkboard and the concrete.

LOOSE INSULATING MATERIALS All loose insulating materials—granulated cork, mineral wool, sawdust, shavings, etc.—are at a distinct disadvantage

Laying down Corkboard for Insulation of Bottom of Freezing Tanks. Merchants Ice and Cold Storage Company's Plant, Cincinnati, Ohio.

when compared with Nonpareil Corkboard, on account of the retaining walls or sheathing that they require to hold them in place, which naturally increase the cost of construction. It is, moreover, impossible to render them moisture proof, and every one, with the exception of granulated

cork, will inevitably become waterlogged. Another serious objection lies in the fact that they are all bound to settle; furthermore, if a break occurs in the retaining wall, part of the filler is apt to run out, in either event leaving spaces here and there empty and unprotected.

VI. Nonpareil Corkboard Occupies Minimum Space.

On account of its low heat conductivity and the solid and compact construction which it renders possible, Nonpareil Corkboard insulation requires the least amount of space of any insulating material, and thus saves storage room. The importance of this phase of the question is frequently overlooked, but an illustration will show how important it really is:

SAVING IN STORAGE ROOM

In a cold storage warehouse there is a room to insulate, measuring twenty by thirty by ten feet high, designed to hold a temperature of 5° F. above zero. This would require five inches of Nonpareil Corkboard (six and one-half inches with cement mortar and plaster finish), or seventeen inches of boards and air space construction, i. e., twelve boards and five air spaces, which construction would be about equivalent in insulating efficiency to the five inches of Nonpareil. By installing the corkboard, ten and a half inches would be saved all around the room; or in other words, 1535 cubic feet of storage space, or 25.5 per cent of the gross cubical contents of the room. In a warehouse where the first cost of space, including land value is forty cents a cubic foot, this space would be worth $614.00, which would yield, at two cents a cubic foot for six

A CONCRETE ILLUSTRATION

months in the year, an annual return of $184.20. Furthermore, the boards and air space insulation would cost just as much at the present prices of lumber, if not more, than the five inches of corkboard, and besides, would rot out and have to be renewed every five or six years. The space saved by installing Nonpareil Corkboard will in itself go quite a long way in offsetting the initial cost.

VII. Nonpareil Corkboard is the Least Expensive Insulation in the Long Run.

Probably the most common argument advanced in the past against Nonpareil Corkboard has been that its cost is excessive. In recent years, however, improved methods of manufacture, larger factories, and increased output have so decreased the cost of production, that even in initial cost it now compares favorably with any type of competing material. Comparison is out of the question, if in addition, its durability and long life in service are taken into consideration.

INITIAL COST NOT EXCESSIVE

True economy looks beneath price into quality, it has nothing in common with the penny wise and pound foolish policy; it addresses itself to the man who is willing to weigh present figures in the light of future returns. The number of plant owners, who have come to look beyond mere first cost, who realize the value of honest insulation properly designed and installed, has been steadily increasing. For such, the following illustration, which shows clearly the dividend paying capacity of Nonpareil Corkboard Insulation, will have particular interest:

A TYPICAL CASE

Let us assume that there is to be erected in Pittsburgh, Pa., a cold storage room designed to hold a temperature of 5° F., twenty by thirty by ten feet high. The brick walls are to be thirteen inches thick; the ceiling and floor are to consist of six inches of concrete. The mean annual temperature in Pittsburgh, according to the United States Weather Bureau, is approximately 53° F.; hence the average difference between the temperature of this contemplated cold storage room and the outside air would be 48° F.

WITHOUT INSULATION

Careful calculation shows that without any insulation whatsoever, the transmission through the bare walls, floor and ceiling, would amount to 526,100,000 B. T. U. every year. A British Thermal Unit, i. e., B. T. U., is the amount of heat required to raise the temperature of a pound of water one degree Fahrenheit. 288,000 B. T. U. are equivalent to one ton of refrigeration. Therefore, to offset the heat that would leak into the cold storage room, without insulation, 1827 tons of refrigeration would be required, which, at fifty cents a ton, would cost $913.50 per annum.

WITH INSULATION

Let us now insulate the room, applying five inches of Nonpareil Corkboard to the walls and ceiling, putting it up in two courses, one of three-inch, and the other of two-inch material, both in Portland cement, joints broken both ways, with a cement plaster finish. On the six-inch concrete base, both courses of corkboard would be laid down in hot asphalt, the upper surface flooded with the same material, and a four-inch concrete working floor placed on top. Calculating

the heat leakage now with the insulation, it is found that in a year it would amount to only 53,800,000 B. T. U., to offset which would require but 187 tons of refrigeration, costing fifty cents a ton, $93.50. Subtracting this amount from the cost of the refrigeration which would be required if there were no insulation, the net saving is $820.00 per year. The cost of installing Nonpareil Corkboard, as just specified, in Pittsburgh, Pa., including the cement plaster and concrete working floor, would be approximately $1450.00. Hence the insulation would actually pay for itself in twenty-one months, a return on the original investment of fifty-seven per cent per annum. Best of all, it would continue paying the same dividend every year so long as the building remained standing, as it does not deteriorate in service.

THE SAVING

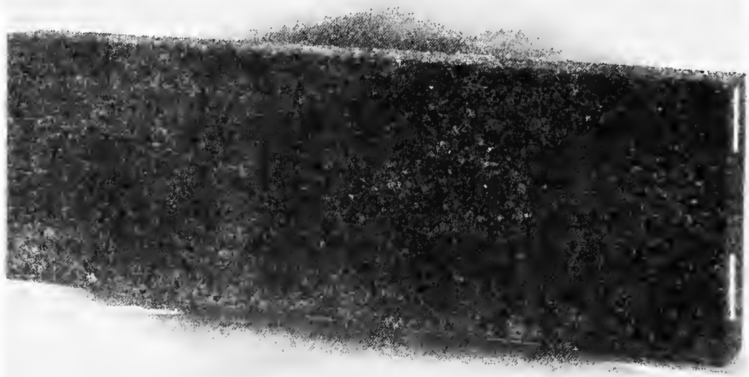
Cheaper materials there are in first cost. Perhaps they will do the work that is expected of them for a time, but sooner or later condensation will get in its deadly work. The insulation will become waterlogged and inefficient, and eventually will have to be torn out and replaced at great expense and inconvenience. The time to insulate properly is when the building is erected.

Factory at Camden, New Jersey. This plant, covering six acres, is devoted exclusively to the manufacture of Nonpareil Corkboard and Nonpareil Cork Pipe Covering.

Nonpareil Wood Inserted Corkboard

(Patented)

Besides regular Nonpareil Corkboard, a special grade of this material, known as Nonpareil Wood Inserted Corkboard, is manufactured for use where, for special reasons, it may be desirable to apply a lumber instead of a plaster finish. Wooden strips three inches wide and five-



Nonpareil Wood Inserted Corkboard.

eighths of an inch thick are placed in the center of the cork sheets during the process of manufacture. They run the length of the board, giving it stiffness and affording a firm hold for nails, without materially decreasing the insulating efficiency. Nonpareil Wood Inserted Corkboard is manufactured only in sheets two and three inches thick; standard size twelve by thirty-six inches.

Service Details

The proper thickness of Nonpareil Corkboard to install, in order to maintain a given temperature economically, depends, as with every other type of insulation, upon several factors, which vary in the case of each plant:

(*a*) The character of the building—whether brick, stone, concrete, hollow tile or frame;

(*b*) The thickness of the walls, floors and ceilings;

(*c*) The temperature to be maintained;

(*d*) The climatic conditions;

(*e*) The character of the material to be stored or the purpose for which the rooms are to be used;

(*f*) The cost of producing refrigeration.

THICKNESS TO INSTALL

Each case that arises must be considered on its own merits. Generally speaking, however, it may be said that under average conditions, the thicknesses of Nonpareil Corkboard that can be economically installed for the several temperatures noted, are as follows:

Temperatures	Thickness of Nonpareil Corkboard
—10° to 5° F.	Six inches
5° " 20° "	Five "
20° " 32° "	Four "
32° " 45° "	Three "
45° & above	Two "

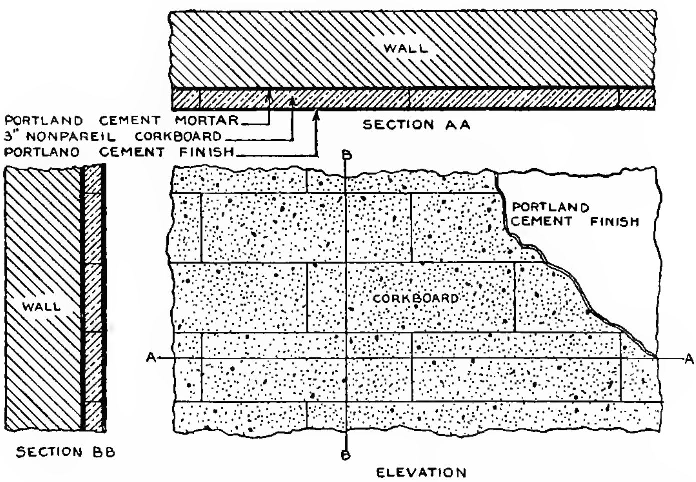
For the bottom of freezing tanks, five inches or preferably six inches of Nonpareil Corkboard should be employed; around the sides the same thickness of corkboard, or twelve inches of granulated cork securely tamped in place.

Specifications for Erection

The following specifications and accompanying details show those methods of erecting Nonpareil Corkboard which long experience has demonstrated to be the most practical and satisfactory. They cover almost every type of building and with slight modification—changing the thickness of corkboard specified, when necessary—may be used without alteration:

Walls

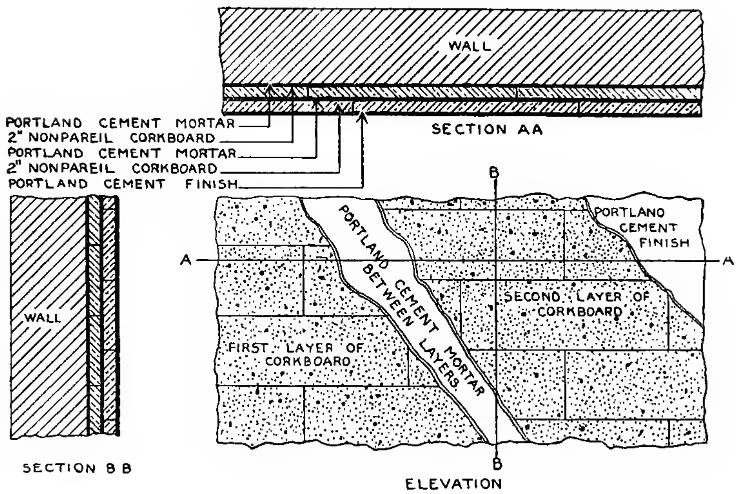
1. WALLS: Brick, stone, concrete or hollow tile. Three-inch insulation—single layer.



Directly against the walls, one layer of 3-inch Nonpareil Corkboard shall be erected in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand. All vertical joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 28.

NOTE: The above specification may be used for any thickness erected in one layer.

2. WALLS: Brick, stone, concrete or hollow tile. Four-inch insulation—two layers.

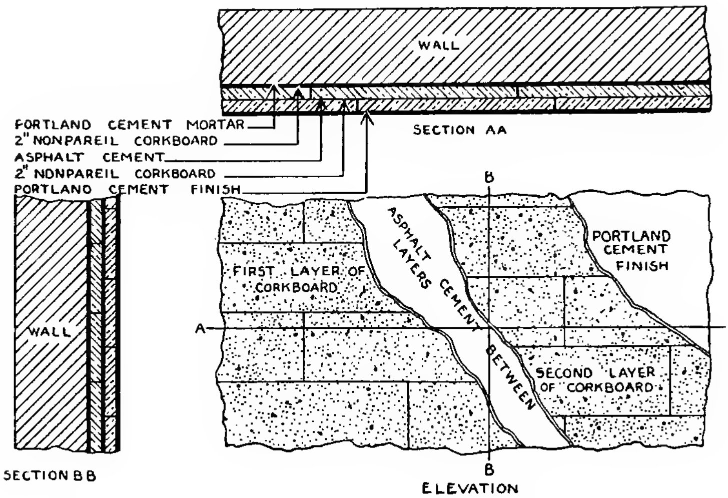


Directly against the walls, one course of 2-inch Nonpareil Corkboard shall be erected in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand, all vertical joints being broken. A second course of 2-inch Nonpareil Corkboard shall then be erected against the first in a ½-inch bed of Portland cement mortar, and additionally secured to the first with galvanized wire nails. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 28.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness erected in two layers.

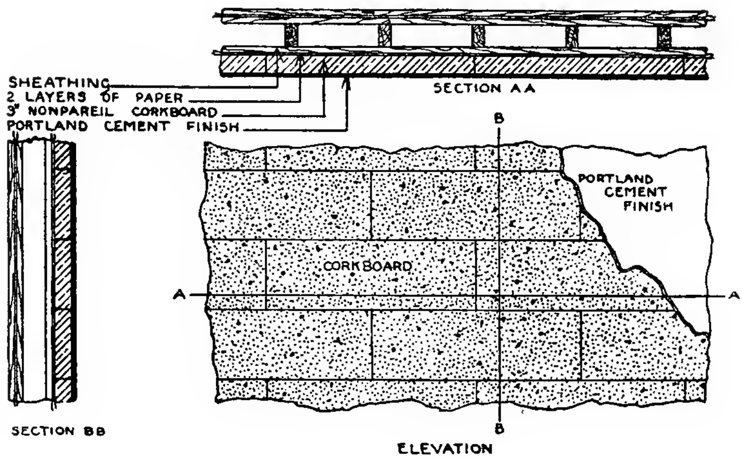
3. WALLS: Brick, stone, concrete or hollow tile. Four-inch insulation—two layers.



Directly against the walls, one course of 2-inch Nonpareil Corkboard shall be erected in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand, all vertical joints being broken. A second course of 2-inch Nonpareil Corkboard shall then be erected against the first in hot asphalt cement and additionally secured to the first with galvanized wire nails. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied, as per Specification No. 28.

NOTE: The above specification may be used for any thickness erected in two layers.

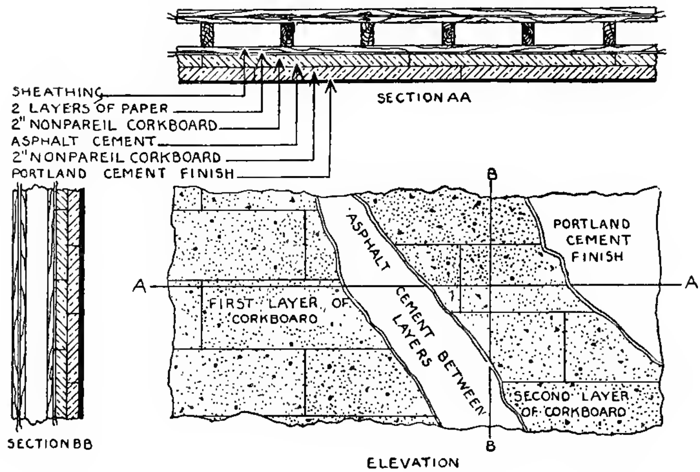
4. WALLS: Frame construction. Three-inch insulation—single layer.



On the sheathed walls, two layers of waterproof insulating paper shall be applied, all edges lapped at least 3 inches, against which shall be securely nailed one course of 3-inch Nonpareil Corkboard. All vertical joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied, as per Specification No. 28.

NOTE: The above specification may be used for any thickness erected in one layer. Hot asphalt may be substituted for the two layers of insulating paper. If desired, the space between the studding may be filled with granulated cork, well tamped in place.

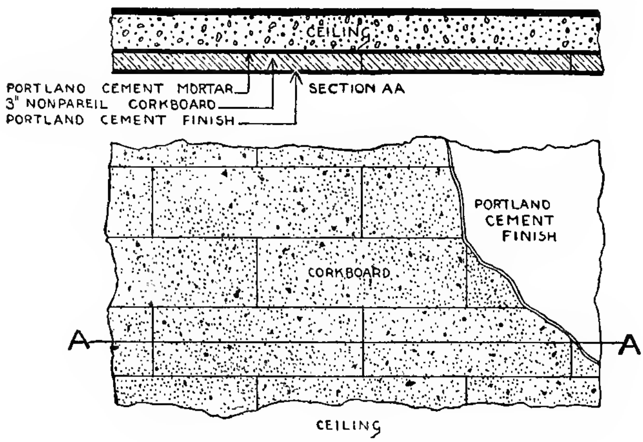
5. WALLS: Frame construction.
Four-inch insulation—two layers.



On the sheathed walls, two layers of waterproof insulating paper shall be applied, all edges lapped at least 3 inches, against which one course of 2-inch Nonpareil Corkboard shall be securely nailed, all vertical joints being broken. A second course of 2-inch Nonpareil Corkboard shall then be erected against the first in hot asphalt cement, and additionally secured to the first with galvanized wire nails. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 28.

NOTE: The above specification may be used for any thickness erected in two layers. Hot asphalt cement may be substituted for the two layers of insulating paper above specified, or vice-versa. If desired, the space between the studding may be filled with granulated cork, well tamped in place.

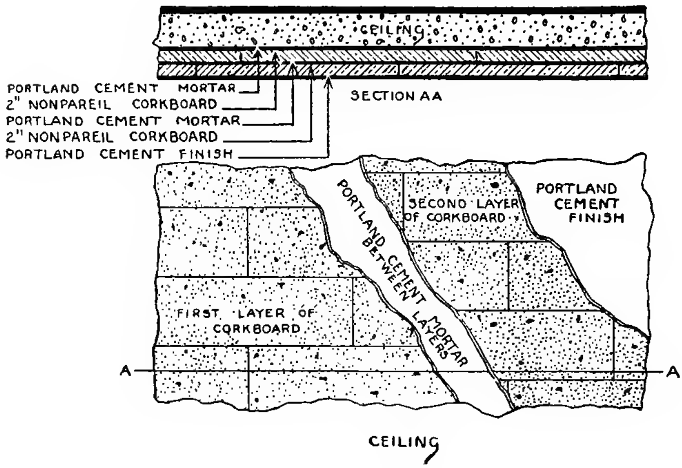
6. CEILINGS: Concrete or hollow tile. Three-inch insulation—single layer.



Directly against the ceiling, one layer of 3-inch Nonpareil Corkboard shall be laid up in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to one part of clean, sharp sand. All transverse joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 28.

NOTE: The above specification may be used for any thickness laid up in one layer.

7. CEILINGS: Concrete or hollow tile.
Four-inch insulation—two layers.

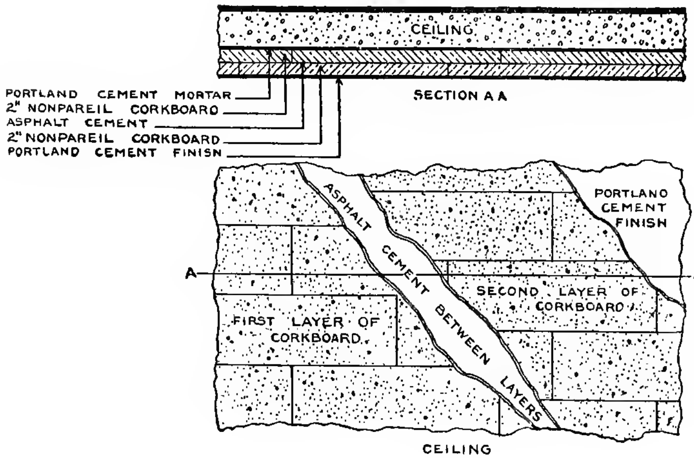


Directly against the ceiling, one course of 2-inch Nonpareil Corkboard shall be laid up in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to one part of clean, sharp sand, all transverse joints being broken. A second course of 2-inch Nonpareil Corkboard shall then be laid up against the first in a ½-inch bed of Portland cement mortar, and additionally secured to the first with galvanized wire nails. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 28.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness laid up in two layers.

8. CEILINGS: Concrete or hollow tile. Four-inch insulation—two layers.

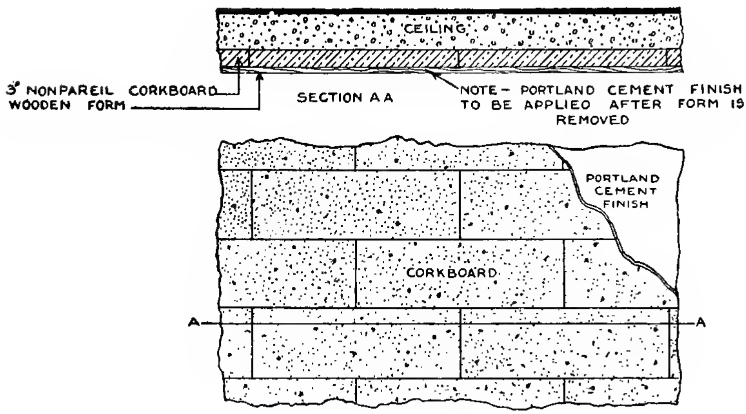


Directly against the ceiling, one course of 2-inch Nonpareil Corkboard shall be laid up in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to one part of clean, sharp sand, all transverse joints being broken. A second course of 2-inch Nonpareil Corkboard shall then be laid up against the first in hot asphalt cement and additionally secured to the first with galvanized wire nails. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 28.

NOTE: The above specification may be used for any thickness laid up in two layers.

9. **CEILING: Concrete.**

Three-inch insulation—one layer laid down in ceiling forms before concrete is poured in.



CEILING

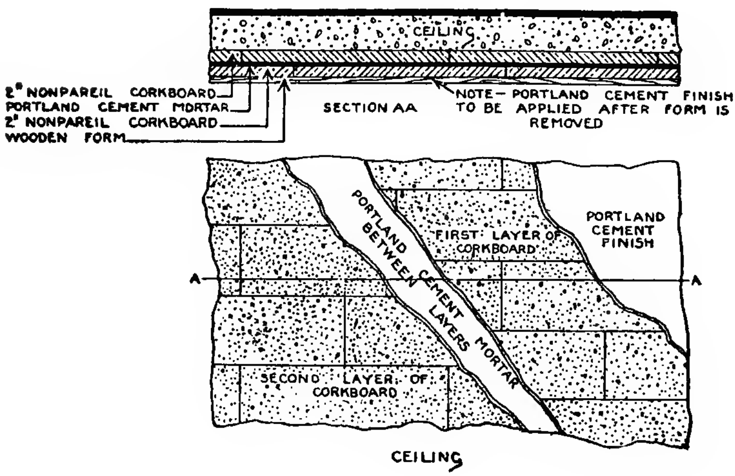
The concrete contractor shall construct the wooden forms for the ceiling 3 inches deeper than would otherwise be necessary. In the concrete forms shall be laid down one course of 3-inch Nonpareil Corkboard. All transverse joints shall be broken. All joints shall be made tight. The forms shall then be filled in with concrete by the concrete contractor. After the forms are removed, a Portland cement plaster finish shall be applied to the exposed surface of the corkboard, as per Specification No. 28.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness laid down in one layer, the depth of the forms to be varied accordingly.

10. CEILINGS: Concrete.

Four-inch insulation—two layers laid down in ceiling forms before concrete is poured in.

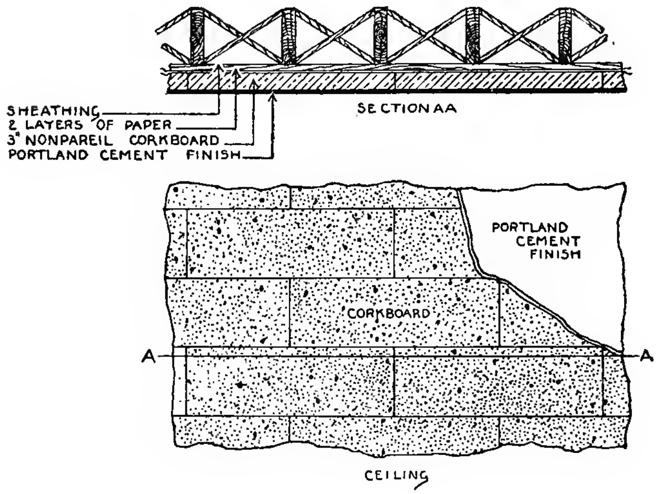


The concrete contractor shall construct the wooden forms for the ceiling 4½ inches deeper than would otherwise be necessary. In the concrete forms shall be laid down one course of 2-inch Nonpareil Corkboard, all transverse joints being broken. On top of the first course, a second course of 2-inch Nonpareil Corkboard shall be laid down in Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The form shall then be filled in with concrete by the concrete contractor. After the forms are removed a Portland cement plaster finish shall be applied to the exposed surface of the corkboard, as per Specification No. 28.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness laid down in two layers, the depth of the forms to be varied accordingly.

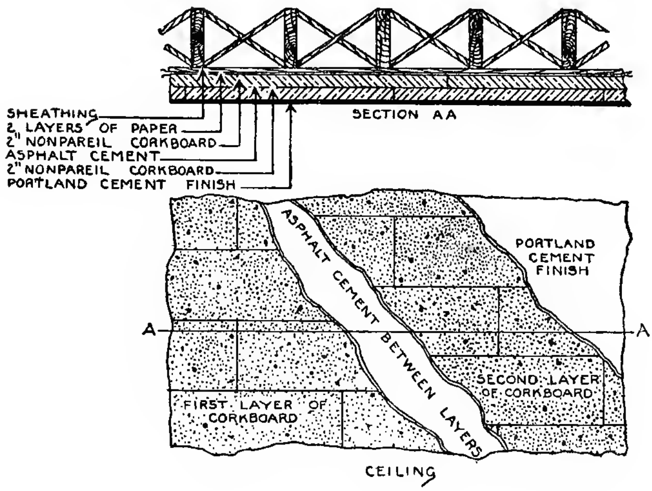
11. CEILINGS: Frame construction. Three-inch insulation—one layer.



On the sheathed ceiling, two layers of waterproof insulating paper shall be applied, all edges lapped at least 3 inches, against which one course of 3-inch Nonpareil Corkboard shall be securely nailed. All transverse joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied, as per Specification No. 28.

NOTE: The above specification may be used for any thickness erected in one layer. Hot asphalt cement may be used instead of two layers of insulating paper. If desired, the space between the joists may be filled with granulated cork, well tamped in place.

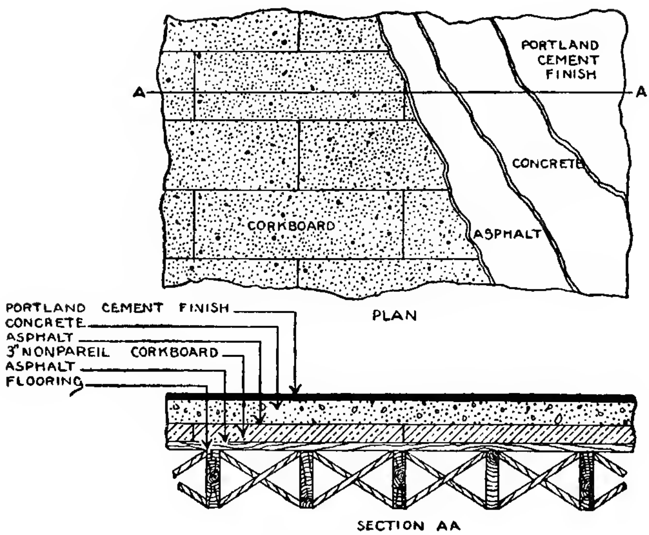
12. CEILINGS: Frame construction. Four-inch insulation—two layers.



On the sheathed ceiling, two layers of waterproof insulating paper shall be applied, all edges lapped at least 3 inches, against which shall be securely nailed one course of 2-inch Nonpareil Corkboard, all transverse joints being broken. A second course of 2-inch Nonpareil Corkboard shall then be erected against the first in hot asphalt cement, and additionally secured to the first with galvanized wire nails. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 28.

NOTE: The above specification may be used for any thickness erected in two layers. Hot asphalt cement may be substituted for the two layers of insulating paper above specified, or vice-versa. If desired, the space between the joists may be filled with granulated cork, well tamped in place.

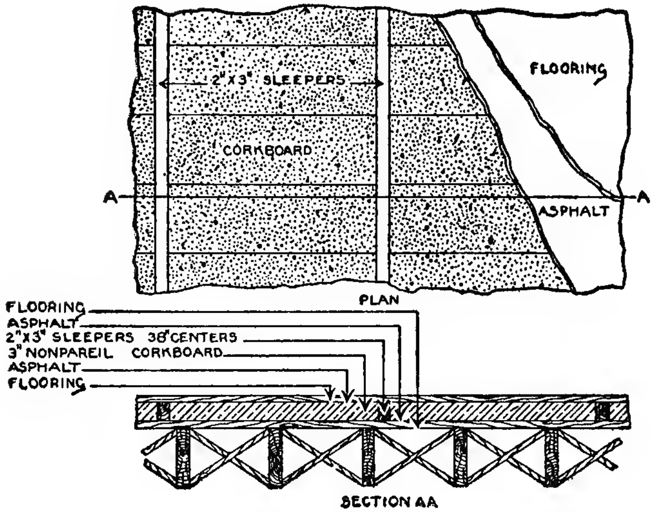
13. FLOORS: Frame construction. Three-inch insulation—one layer, concrete finish.



On the wood flooring, one course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All transverse joints shall be broken. All joints shall be made tight. The upper surface of the corkboard shall be flooded with hot asphalt, approximately ⅛-inch in thickness, and the 4-inch working concrete floor laid down directly on top.

NOTE: The above specification may be used for any thickness laid down in one layer.

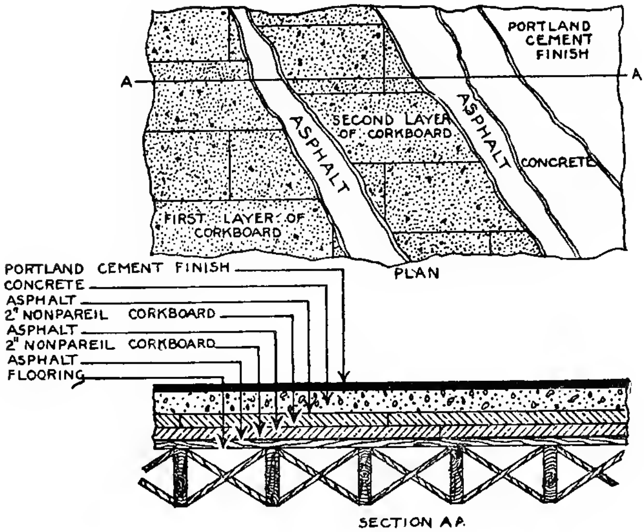
14. FLOORS: Frame construction. Three-inch insulation—one layer, wood finish.



On the wood flooring, 2-inch x 3-inch sleepers shall be laid down on edge on 38-inch centers. Between the sleepers, 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛-inch thick. The flooring shall then be securely nailed down.

NOTE: The above specification may be used for any thickness laid down in one layer, the size of the sleepers to be varied accordingly.

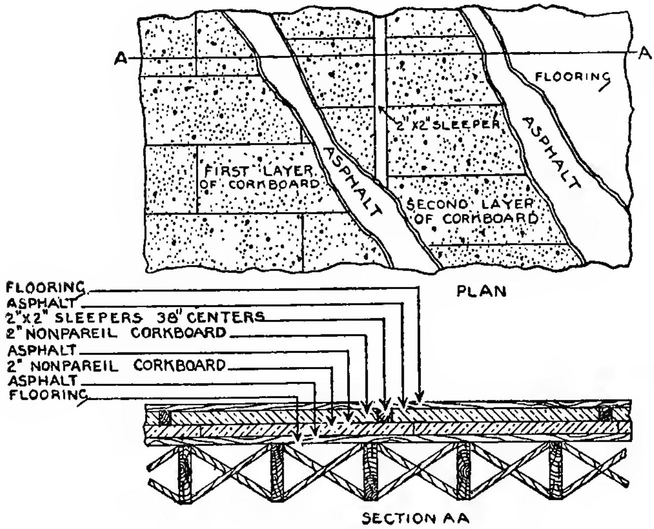
15. FLOORS: Frame construction. Four-inch insulation—two layers, concrete finish.



On the wood flooring, one course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. On the first layer, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛-inch thick, and the 4-inch working concrete floor laid down directly on top.

NOTE: The above specification may be used for any thickness laid down in two layers.

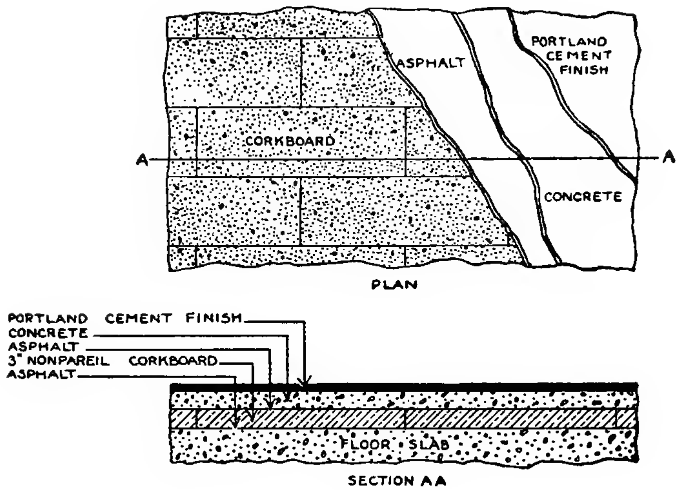
16. FLOORS: Frame construction. Four-inch insulation—two layers, wood finish.



On the wood flooring, one course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. 2-inch x 2-inch sleepers shall then be put down on 38-inch centers. Between the sleepers, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛-inch thick. The flooring shall then be securely nailed down.

NOTE: The above specification may be used for any thickness laid down in two layers. The size of the sleepers must be adjusted to the thickness of the second course of corkboard.

17. FLOORS: Concrete or hollow tile. Three-inch insulation—one layer, concrete finish.

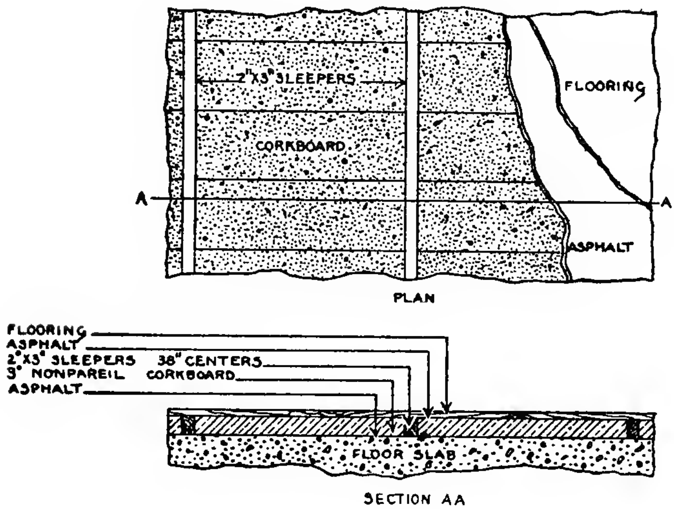


On a reasonably smooth and level concrete base, one course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All transverse joints shall be broken. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛-inch in thickness, and the 4-inch working concrete floor laid down directly on top.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness laid down in one layer.

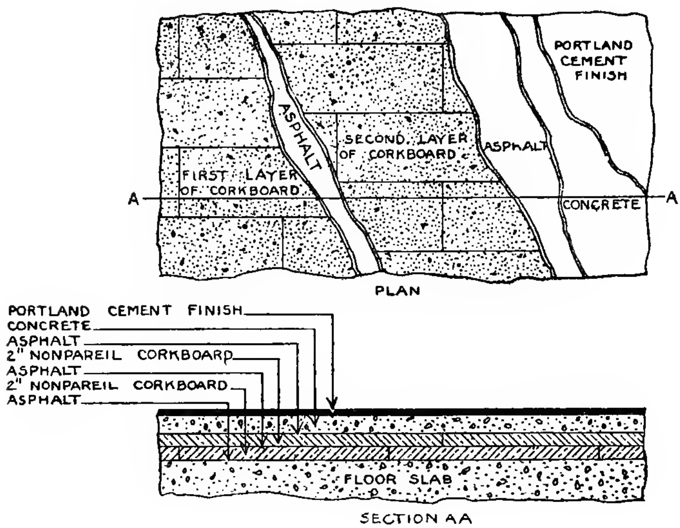
18. FLOORS: Concrete or hollow tile. Three-inch insulation—wood finish.



On a reasonably smooth and level concrete base, 2-inch x 3-inch sleepers shall be laid down on edge in hot asphalt on 38-inch centers. Between the sleepers, 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛-inch thick. The flooring shall then be securely nailed down.

NOTE: The above specification may be used for any thickness laid down in one layer, the size of the sleepers to be varied accordingly.

19. FLOORS: Concrete or hollow tile. Four-inch insulation—two layers, concrete finish.

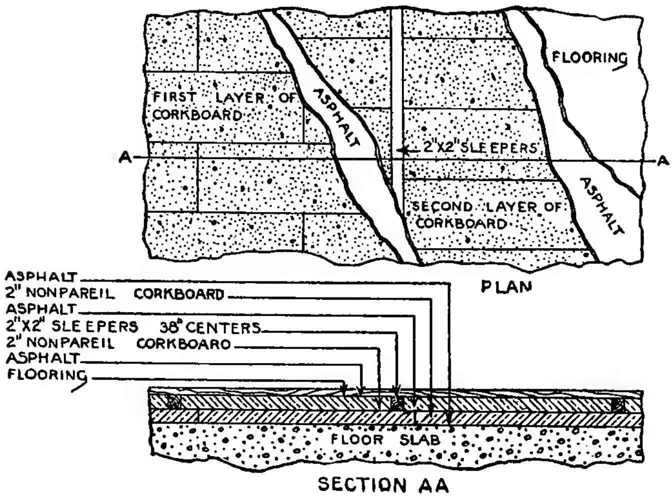


On a reasonably smooth and level concrete base, one course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. On the first course, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛-inch thick, and the 4-inch working concrete floor laid down directly on top.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness laid down in two layers.

20. FLOORS: Concrete or hollow tile. Four-inch insulation—two layers, wood finish.



On a reasonably smooth and level concrete base, one course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. 2-inch x 2-inch sleepers shall then be put down on 38-inch centers. Between the sleepers, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛-inch thick. The flooring shall then be securely nailed down.

NOTE: The above specification may be used for any thickness laid down in two layers. The size of the sleepers must be adjusted to the thickness of the second course of corkboard.

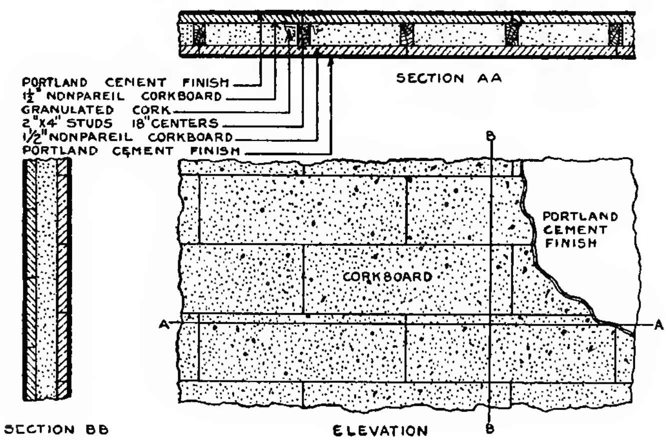
Partitions

There are so many types of partitions that it is possible here only to present those forms that are most frequently met with.

PARTITIONS: Brick, stone, concrete or hollow tile.

Brick, stone, concrete and hollow tile partitions are insulated as per Specifications Nos. 1, 2 and 3 for wall work.

21. PARTITIONS: Frame construction.

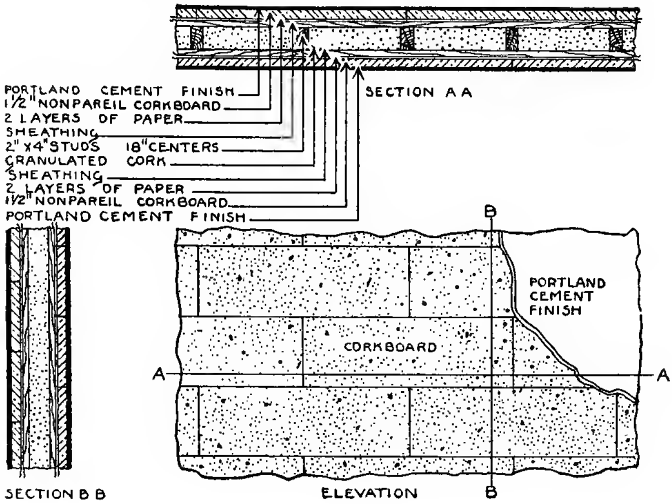


Against both sides of 2-inch x 4-inch studding, erected on 18-inch centers, 1½-inch Nonpareil Corkboard shall be securely nailed. All vertical joints shall be broken. All joints shall be made tight. The space between the studs shall be carefully filled with granulated cork, well tamped in place. A Portland cement plaster finish shall be applied to the exposed surface of the corkboard on both sides of the partition as per Specification No. 28.

NOTE: The above specification may be used for any thickness of corkboard.

A better type of construction is afforded by the following specification:

22. PARTITIONS: Frame construction.



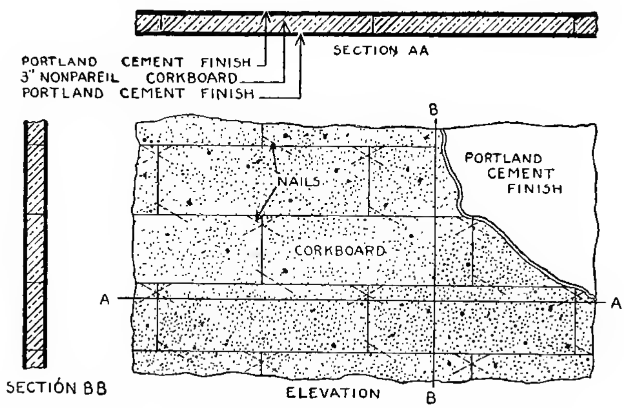
2-inch x 4-inch studding shall be erected on 18-inch centers and sheathed on both sides with ⅞-inch T. & G. boards. Against the sheathing on both sides of the partition shall be applied two layers of waterproof insulating paper, all edges lapped 3 inches, against which one course of 1½-inch Nonpareil Corkboard shall be securely nailed. All vertical joints shall be broken. All joints shall be made tight. The space between the studs shall be filled with granulated cork well tamped in place. A Portland cement plaster finish shall be applied to the exposed surface of the corkboard on both sides of the partition as per Specification No. 28.

NOTE: The thickness of the corkboard should be varied according to the temperature to be maintained. Frequently it is desirable to apply corkboard to only one side of the studding, finishing the other side with matched boards or expanded metal lath and plaster, as may be desired.

Solid Cork Partitions

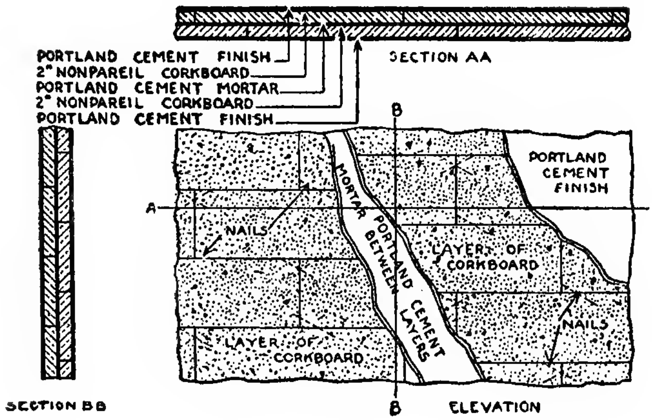
In cases where there is no load to be carried, solid corkboard partitions, as high as fifteen feet, are found entirely satisfactory. They possess remarkable structural strength and save space and the cost of the studding, which would otherwise be required. Specifications for their erection follow:

23. SOLID CORK PARTITIONS:
Three-inch insulation—one layer.



The partition shall be a solid cork partition, consisting of one layer of 3-inch Nonpareil Corkboard built up edge on edge. All joints shall be sealed with hot asphalt and made tight. All vertical joints shall be broken and each corkboard securely toe-nailed to the abutting corkboards, and, where possible, to the walls, floor and ceiling, with long special galvanized wire nails. A Portland cement plaster finish shall be applied to both sides of the corkboard as per Specification No. 28.

24. SOLID CORK PARTITIONS:
Four-inch insulation—two layers.

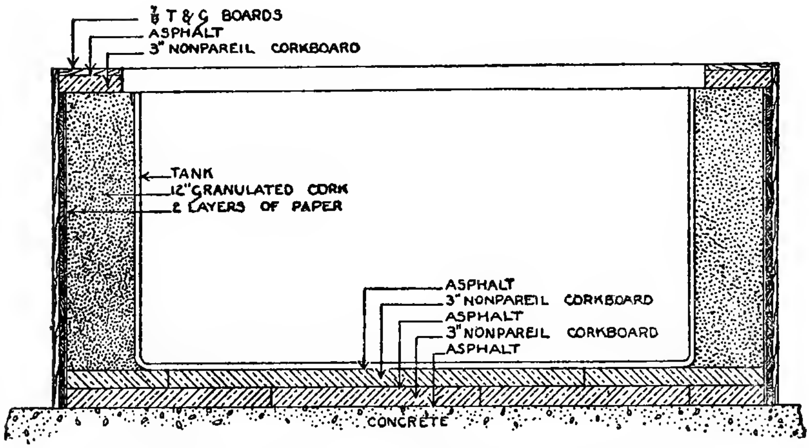


The partition shall be a solid cork partition, built up as follows: One layer of 2-inch Nonpareil Corkboard shall be erected edge on edge. All joints shall be sealed with hot asphalt and made tight. All vertical joints shall be broken and each corkboard securely toe-nailed to the abutting corkboards, and, where possible, to the walls, floor and ceiling, with long special galvanized wire nails. Against this first layer, a second layer of 2-inch Nonpareil Corkboard shall be erected in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand, and additionally secured to the first layer with galvanized wire nails. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied to both sides of the partition as per Specification No. 28.

NOTE: The above specification may be used also for 5-inch solid cork partitions, consisting of one course of 2-inch and a second of 3-inch corkboard; or for 6-inch partitions, consisting of two layers of 3-inch corkboard.

25. FREEZING TANKS:

Six inches Nonpareil Corkboard underneath.
Twelve inches Granulated Cork on sides.



BOTTOM: On a reasonably smooth and level concrete base, one course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. On the first course, a second course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface of the corkboard shall then be flooded with hot asphalt, approximately ⅛-inch thick, and left ready for the tank to be set down directly on top. The insulation shall extend at least 12 inches beyond the sides of the tank.

NOTE: Experience has shown that heavy insulation on the bottom of freezing tanks will materially increase their output. Although some engineers specify only two layers of 2-inch Nonpareil Corkboard for this purpose, 5 inches, i. e., one layer of 2-inch and another of 3-inch; or preferably 6 inches, as above specified, should always be used.

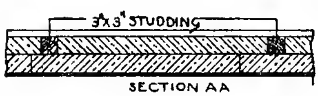
SIDES: Retaining walls of lumber shall be constructed so as to leave a space of 12 inches all around the four sides of the tank. Against the inside of the retaining walls shall

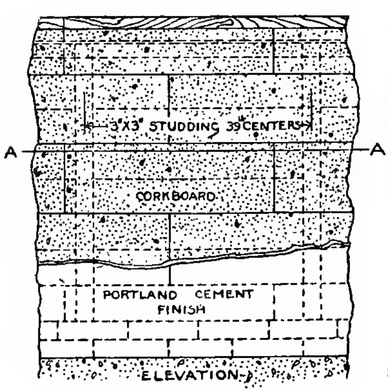
be applied two layers of waterproof insulating paper, all edges lapped at least 3 inches. The space between the walls and the tank shall be filled with granulated cork, well tamped in place. The space filled with granulated cork shall then be covered with 3-inch Nonpareil Corkboard flooded with asphalt. The corkboard shall be protected with ⅞-inch T. & G. boards.

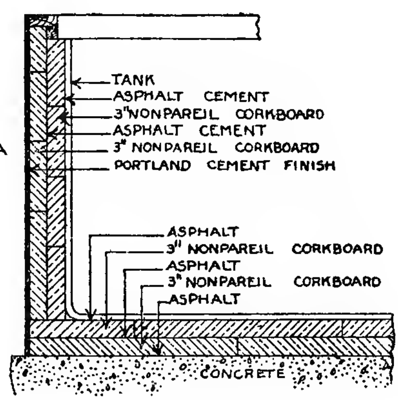
NOTE: Practice has shown that 12 inches of granulated cork is the proper thickness to employ. If circumstances render it necessary, this may be reduced to 10 inches without serious harm. If the retaining walls are of brick, they should be waterproofed with hot asphalt.

26. FREEZING TANKS:

Six inches Nonpareil Corkboard underneath.
Six inches Nonpareil Corkboard on sides.







BOTTOM: On a reasonably smooth and level concrete base, one course of 3-inch Nonpareil Corkboard shall be laid

down in hot asphalt, all transverse joints being broken. On the first course, a second course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface of the corkboard shall then be flooded with hot asphalt, approximately ⅛-inch thick, and left ready for the tank to be set down directly on top. The insulation shall extend at least 6 inches beyond the sides of the tank.

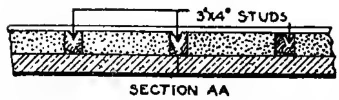
NOTE: See note under Specification No. 25.

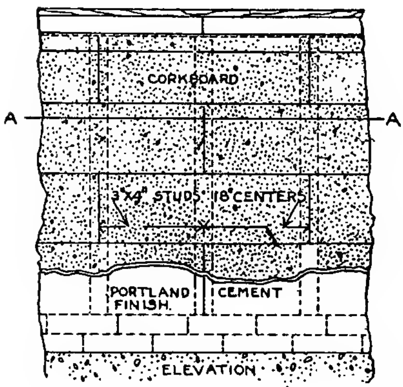
SIDES: Against the sides of the tank, 3-inch x 3-inch studs shall be set on 39-inch centers, the upper end of each stud being securely wedged in place. 3-inch Nonpareil Corkboard shall then be laid up between the studs against the side of the tank in hot asphalt cement and securely toe-nailed to the studding. Against the first course, a second course of 3-inch Nonpareil Corkboard shall be erected in hot asphalt cement and securely nailed to the studding, and also to the first course of corkboard. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. Against the exposed surface of the corkboard a Portland cement plaster finish shall be applied as per Specification No. 28.

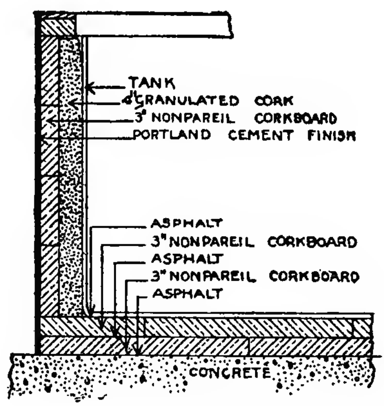
NOTE: Not less than 6 inches of Nonpareil Corkboard should be used in insulating the sides of freezing tanks, but if peculiar circumstances render it necessary to reduce the insulation to 5 inches, 2-inch x 4-inch studs should be erected flat against the sides of the tank on 40-inch centers. 2-inch corkboard should then be applied, followed by one course of 3-inch material. The combination of sheet and granulated cork, as per Specification No. 27, is to be highly recommended.

27. FREEZING TANKS:

Six inches Nonpareil Corkboard underneath.
Four inches Granulated Cork and
Three inches Nonpareil Corkboard on sides.







BOTTOM: On a reasonably smooth and level concrete base, one course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. On the first course, a second course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface of the corkboard shall then be flooded with hot asphalt, approximately ⅛-inch thick, and left ready for the tank to be set down directly on top. The insulation shall extend at least 6 inches beyond the sides of the tank.

NOTE: See note under Specification No. 25.

SIDES: Against the sides of the tank, 3-inch x 4-inch studs shall be set on edge on 18-inch centers, the upper ends being securely wedged in place. Against the studs, one course of 3-inch Nonpareil Corkboard shall be securely nailed. All vertical joints shall be broken. All joints shall be sealed with asphalt cement. The space between the studs, the sides of the tank, and the corkboard, shall be filled with granulated cork, well tamped in place. On the exposed surface of the corkboard, a Portland cement plaster finish shall be applied as per Specification No. 28.

NOTE: If desired, a matched lumber finish may be applied instead of the Portland cement plaster specified.

Portland Cement Plaster Finish

28. Against the exposed surface of the corkboard, a Portland cement plaster finish, approximately ½-inch in thickness, shall be applied in two coats. The first shall be approximately ¼-inch in thickness, rough scratched, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand. After this coat has thoroughly dried, the second coat shall be applied approximately ¼-inch in thickness, mixed in the proportion of one part of Portland Cement to one and one-half parts of clean, sharp sand, and brought to a float or trowel finish, as may be desired. The plaster shall be kept wet by daily sprinkling for at least a week after the second coat is applied, in order to reduce cracking to a minimum.

NOTE: It is frequently desirable to score the surface, marking it off in 3 or 4-foot squares. Whatever cracking there is then takes place in the score marks, and hence is not noticeable. Portland cement contracts in setting and hence is bound to crack to a certain extent, but this does not affect the efficiency of the insulation in the slightest. After the plaster has thoroughly dried out, all cracks may be filled up with neat cement, and the plaster then given one or two coats of cold water paint or white enamel.

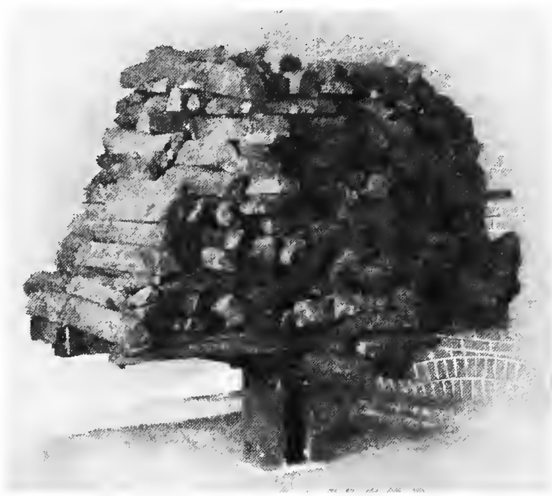
Cold Storage Insulation Contract Department

Our Contract Department is in position to submit plans, specifications and estimates on any work, large or small, involving cork insulation, and, with its corps of experienced erecting superintendents, to execute contracts, however large they may be, with promptness and in a thoroughly workmanlike manner. All such contract work is backed by the guarantee of the Armstrong Cork Company. Years of experience in this particular field have yielded a mass of practical data, which is at the service of all our prospective customers. Through our extended experience, we are frequently able to draw up plans or suggest modifications which result not only in saving in initial cost of construction, but also in more economical operation.

Genuine German Impregnated Corkboard

Genuine German Impregnated Corkboard, manufactured and sold in America exclusively by the Armstrong Cork Company, under patent rights secured from the original German manufacturers, Grünzweig & Hartmann, Ludwigshafen am Rhein, has been recognized for the past twenty years
DESCRIPTION as the standard type of cold storage insulation in Europe. It consists of granulated cork coated with a fireproofing clay, made up into board form, baked and then thoroughly impregnated with hot asphalt under tremendous pressure. All excess asphalt is finally sucked out by means of a vacuum, leaving each separate granule of cork coated with asphalt but with

interstices between. The process through which Genuine German Impregnated Corkboard passes resembles somewhat that used in creosoting lumber. It results in a very strong board from a structural



Compression Test on four-inch Concrete Floor insulated with five inches of Impregnated Corkboard. Tested with load of pig iron.

Load Per Square Foot	Deflection
2000 pounds	.01 inch
3500 "	.02 "
7500 "	.03 "
9000 "	.04 "
15500 "	.08 "
20000 "	.10 "

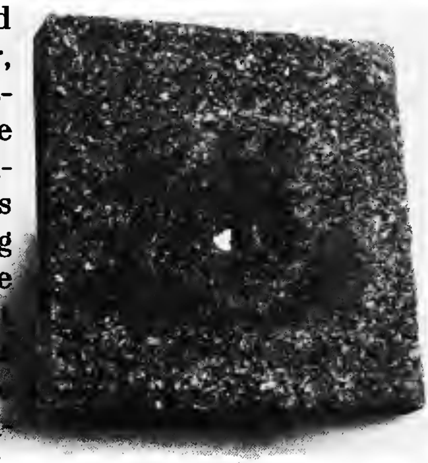
The Concrete did not crack at all.

standpoint, one that does not crumble or disintegrate. It has been used in insulating concrete floors under large tanks, where the concentrated load ran as high as 12,000 pounds to the square foot.

The heat conductivity of Genuine German Impregnated Corkboard per inch thickness is not as low as that of Nonpareil Corkboard. Genuine German Impregnated, however, appeals especially to those architects, engineers and consumers, who

ADVANTAGES

remain firmly of the opinion that asphalt or pitch in some form should properly enter into the insulation of every cold storage room. It is peculiarly well adapted for use in breweries—fermenting cellars, chip cask cellars, racking rooms, etc.—and generally wherever, on account of excessive dampness, service conditions are particularly severe. It is very slow burning and an excellent fire retardant, as the cut on this page gives evidence. It can be handled just like ordinary lumber, cut, sawed, nailed, etc., or erected in Portland cement, following any of the methods hereinbefore outlined for Nonpareil Corkboard. A cement plaster finish adheres readily to its surface.



Fire Test on Impregnated Corkboard. Condition of specimen two inches in thickness, after 1500° F. flame had been applied for eight hours and fifteen minutes.

IMITATIONS INFERIOR

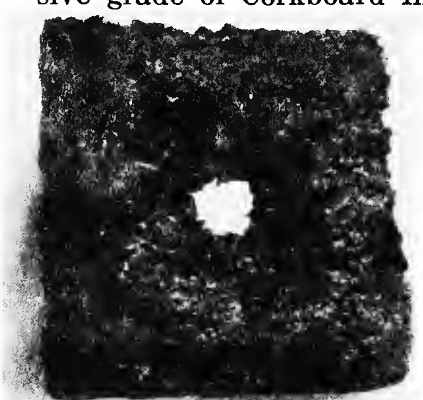
All architects and engineers who wish to have *real* Impregnated Corkboard are requested to specify "Genuine German Impregnated Corkboard," as such action on their part will prevent the substitution of cheap imitations. Several

such have been placed on the market in recent years, the name *Impregnated* having been pirated; as applied to these imitations, it is distinctly misleading, and not in any way descriptive of such materials or the methods employed in their manufacture. Without exception, these so-called impregnated corkboards consist merely of a mechanical mixture of cork and pitch, or cork and asphalt, compressed in large blocks and sawed, or else molded into sheets of the proper dimensions. They are, too, without exception, weak structurally; liable to disintegrate and all go to pieces with astounding rapidity under the action of fire.

Acme Corkboard

DESCRIPTION

Acme Corkboard, the third and least expensive grade of Corkboard Insulation manufactured by the Armstrong Cork Company, consists of granulated cork mixed with hot asphalt, slightly compressed in large blocks, which, when cool, are sawed into sheets of the proper dimensions. It was put on the market originally to meet cheap competition with boards of the type now falsely called Impregnated Corkboard. Its heat conductivity is approximately 8.8 B. T. U.

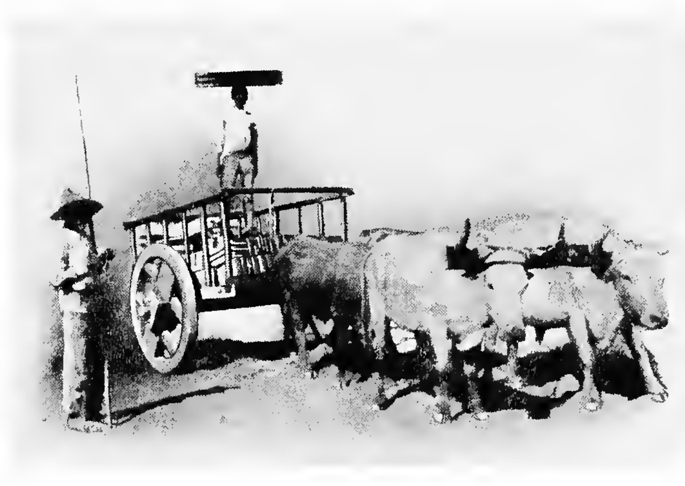


Fire Test on Acme Corkboard. Condition of specimen two inches in thickness after 1500° F. flame had been applied for thirty-five minutes.

per inch thickness, per square foot, per degree difference in temperature, for twenty-four hours.

POINTS OF SUPERIORITY

If a cheap form of insulation must be used, a better type than Acme Corkboard cannot be found. In its manufacture, a high grade odorless asphalt is employed. In other similar forms of corkboard, pitch is the binder, and wherever pitch is used in any connection in insulating rooms where food stuffs, such as milk, cream, butter, eggs, ice cream, etc., are to be stored, there is great danger of tainting. Acme Corkboard can be readily erected in any type of building. In insulating floors and underneath freezing tanks, it can at times be used to particular advantage. The sheets are sawed to accurate dimensions and are full size.



Modern Insulation—Ancient Transportation.
Hauling Nonpareil Corkboard in Mexico.

Dimensions and Shipping Weights

Material	Thick-ness Inches	Number Boards per Crate	Square Feet per Crate	Gross Weight per Crate Pounds	Gross Weight per Sq. Ft. Pounds	Net Weight per Sq. Ft. Pounds
NONPAREIL CORKBOARD	1	48	144	196	1.36	1.15
	1½	32	96	184	1.92	1.60
	2	24	72	174	2.42	2.00
	3	16	48	174	3.63	3.00
NONPAREIL WOOD INSERTED CORKBOARD	2	24	72	225	3.12	2.70
	3	16	48	201	4.18	3.55
GENUINE GERMAN IMPREG-NATED CORKBOARD	1½	30	90	309	3.43	3.10
	2	24	72	311	4.32	3.90
	2½	18	54	276	5.12	4.55
	3	16	48	285	5.94	5.30
	4	12	36	282	7.84	7.00
ACME CORKBOARD	1½	32	96	260	2.71	2.40
	2	24	72	260	3.62	3.20
	2½	18	54	246	4.56	4.00
	3	16	48	260	5.42	4.80
	4	12	36	260	7.23	6.40

Standard Size, 12 x 36 inches

Nonpareil Corkboard and Nonpareil Wood Inserted Corkboard are shipped either from Beaver Falls, Pa., or Camden, N. J. Less than carload shipments have to be crated; carload lots are forwarded in bulk.

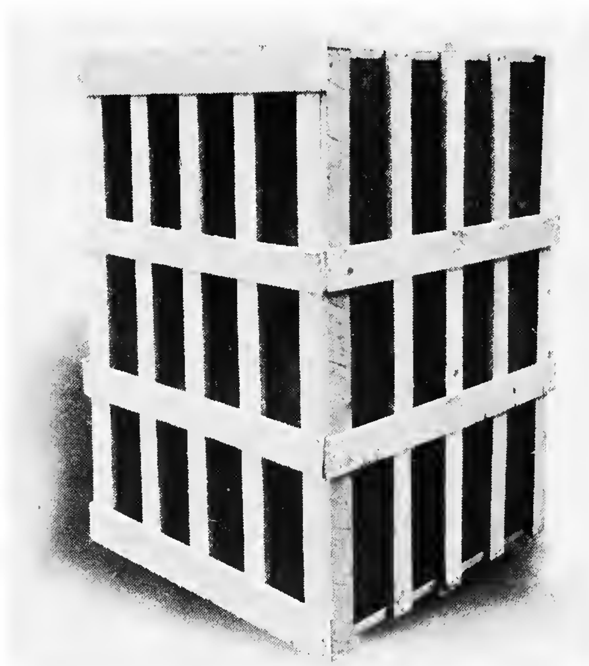
Minimum Carloads: In the territory governed by the Official Freight Classification, 20,000 lbs.; Southern, Western and Transcontinental Classification, 24,000 lbs.

Impregnated and Acme Corkboard are shipped only from Beaver Falls, Pa. Less than carload shipments have to be crated; carload lots are forwarded in bulk.

Minimum Carloads: Throughout the United States, 24,000 lbs.

Freight Rates on Corkboard

All grades of Corkboard take third class in less carloads; fifth class in carloads, under the Official, Southern and Western Freight Classifications. In the Transcontinental Classification corkboard takes a special commodity rate.



Crate of Nonpareil Corkboard.

Granulated Cork

Granulated Cork is manufactured in a number of grades of different degrees of fineness. The coarsest, Unscreened Granulated Cork, the standard grade for insulating purposes, will all pass through a one-half inch mesh screen; 8/20 Granulated Cork will pass through an eight-mesh screen but be caught on a twenty-mesh screen, etc. The following table shows the various grades of granulated cork, together with the weight per cubic foot:

Unscreened Granulated Cork -	6½ lbs. per cu. ft.
Screened Granulated Cork	6 " " " "
8/12 Granulated Cork - - -	9 " " " "
8/20 Granulated Cork	11 " " " "
12/20 Granulated Cork	12½ " " " "

Shipment of Unscreened and Screened Granulated Cork is made from Beaver Falls, Pa., Pittsburgh, Pa., or Camden, N. J., at the Company's option. These materials are shipped in large bags holding from eighty to one hundred pounds each.

Shipment of 8/12, 8/20 and 12/20 Granulated Cork is made from Beaver Falls, Pa., or Camden, N. J., at the Company's option. These materials are shipped in small bags holding from fifty to sixty pounds each.

REGRANULATED CORK Regranulated Cork is a by-product, consisting of the sawings and trimmings from Nonpareil Corkboard. The baking process, through which it passes, serves to enhance the insulating efficiency of the raw cork in three

ways; viz., by driving off a part of the volatile matter and thus increasing the volume of air contained in its minute air cells; second, by thoroughly drying it out; third, the natural gum of the cork is liquified by the heat, and spreads out over the surface of each particle, thus effectually preventing the re-entrance of moisture. As a heat insulator, Regranulated Cork surpasses in efficiency all other loose insulating materials. It has the added advantage of being exceedingly durable and comparatively cheap.

Regranulated Cork is chocolate brown in color, and is manufactured in three grades:

Fine Regranulated Cork	8	lbs. per cu. ft.
Coarse Regranulated Cork	7	" " " "
Coarse and Fine Mixed	7½	" " " "

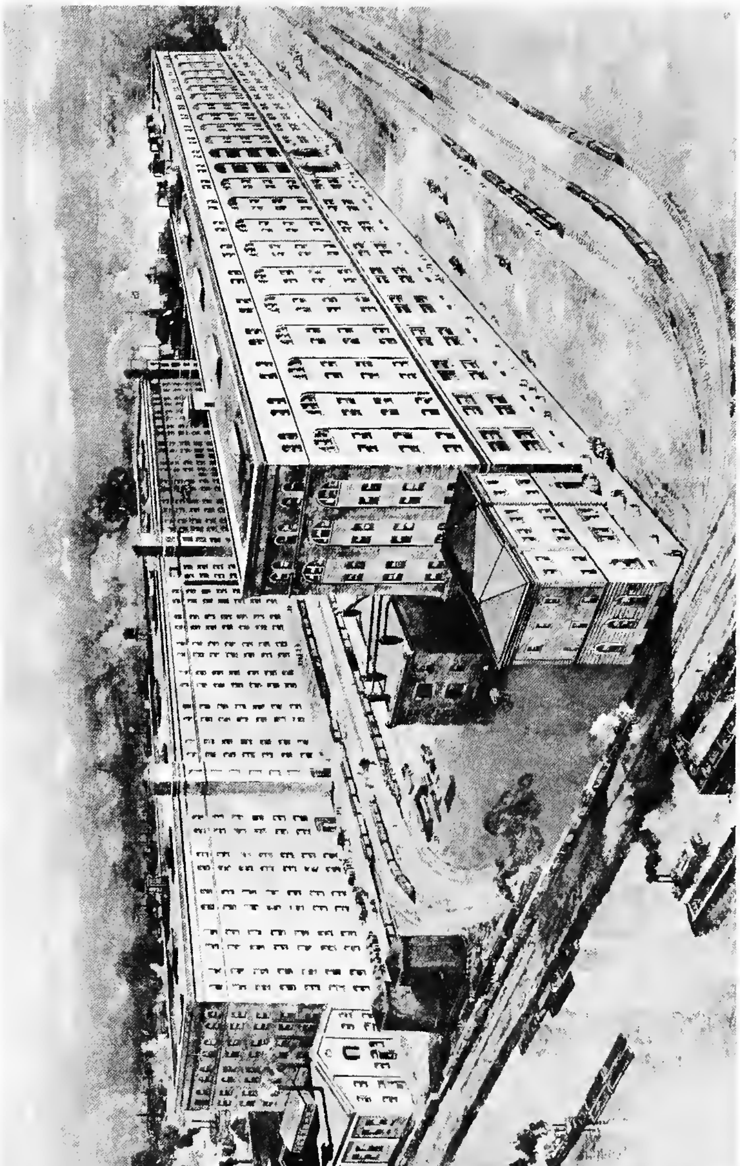
All quotations on Regranulated Cork are made subject to prior sale; shipment is made from either Beaver Falls, Pa., or Camden, N. J., at the Company's option. Regranulated Cork is shipped in small bags holding from forty to fifty pounds each.

Freight Rates Granulated and Regranulated Cork

	Less Carloads	Carloads
Official Classification	First Class	Third Class
Southern Classification	First Class	Fifth Class
Western Classification	First Class	Second Class
Transcontinental Classification	First Class	Special

Minimum Carloads

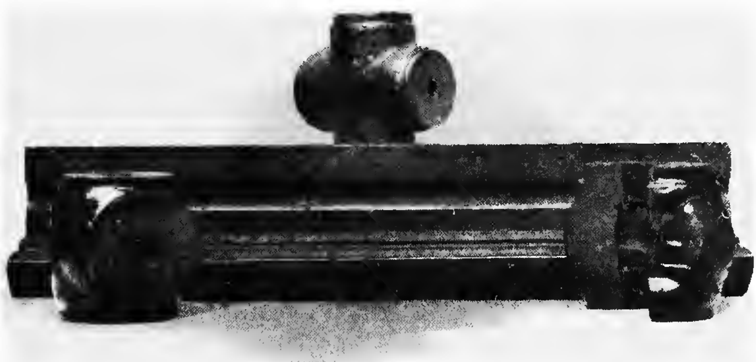
Official Classification	12,000	pounds
Southern Classification	24,000	"
Western Classification	12,000	"
Transcontinental Classification	24,000	"



The Factory at Pittsburgh.

Nonpareil Cork Pipe Covering

Nonpareil Cork Pipe Covering consists, just as Nonpareil Corkboard, of pure granulated cork, slightly compressed and molded in sectional form to fit the many different sizes of pipe and kinds of fittings, screwed and flanged. The covering is coated inside and out with a mineral rubber finish and is applied with waterproof cement on the joints, thus rendering it impervious to moisture.



Nonpareil Cork Pipe Covering.

Nonpareil Cork Pipe Covering is manufactured in four thicknesses to meet different service conditions. If satisfactory results are to be secured, the proper grade must be used and the material carefully applied.

1. *Special Thick Brine Covering*, from three inches to four inches in thickness, is manufactured to meet the demand for extra heavy covering for brine lines, where, owing to the temperature of the refrigerant, the service conditions are particularly severe.

2. *Heavy,* or *Brine Covering,* from two inches to three inches thick, is designed for brine and ammonia gas lines, and generally where the refrigerant has a temperature below 32° F.

3. *Medium,* or *Ice Water Covering,* approximately one and one-half inches thick, is intended for use on refrigerated drinking water, liquid ammonia, and beer lines, and generally where temperatures of 32° F. to 45° F. are carried.

4. *Light,* or *Cold Water Covering,* approximately one inch thick, is for use on cold water piping to prevent sweating.

In laying out pipe lines, ample space should be allowed to permit the application of covering of the proper thickness.

Price list on Nonpareil Cork Pipe Covering will be forwarded on application.

Factories

Our factories at Beaver Falls, Pa., and Camden, N. J., covering twelve and six acres, respectively, are the largest plants in the world devoted exclusively to the manufacture of cork insulating materials. Their capacity is ample to take care of orders of any size with promptness and despatch. A large supply of corkboard, granulated cork, and cork pipe covering is carried constantly in stock.

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THE CORDAY & GROSS CO
CLEVELAND